Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

FEBRUARY ★ 1951

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

Page 117—Journal Section of the American Society of Heating and Ventilating Engineers

Sidewalk snow melting system proves value in record snow . . . page 75

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Complete contents, page 3 . . . Data Sheet, page 132 . . . Save Lewis' Page 111 . . . Question of the Month, page 119

ADJUSTABLE PIPE HANGERS AND SUPPORTS

for every piping requirement

No. 2 OF A SERIES SHOWING THE GRINNELL LINE

malleable iron clamps for fire protection, plumbing, and heating up to 450°F

I-Beam Clamp
fig. 131
for 2 to 6-in. flange

Center I-Beam Clamp
fig. 217
safe load: 150 lb

Simplex Top Beam Clamp
fig. 267 — safe load: 150 to 2300 lb

Swinging Top Beam Clamp
fig. 270 — safe load: 150 to 2300 lb

Universal Channel Clamp
fig. 226 — safe load: 150 to 2300 lb

Channel Extension Clamp
fig. 219
safe load: 150 lb

Simplex Channel Clamp
fig. 266 — safe load: 150 to 2300 lb

Universal Side I-Beam Clamp
fig. 225 — safe load: 150 to 2300 lb

Simplex Side I-Beam Clamp
fig. 265 — safe load: 150 to 2300 lb

C-Clamp
fig. 88
$\frac{3}{8}$ to $\frac{1}{4}$ -in. rod.

steel I-beam clamps for process and power plant service

UFS W-F I-Beam Clamp With Links and Weldless Eye Nut — fig. 293
safe loads: up to 11,500 lb

UFS I-Beam Clamp with Weldless Eye Nut
fig. 292 — safe loads: up to 11,500 lb

UFS W-F I-Beam Clamp With Links
fig. 294 — safe loads: up to 11,500 lb

UFS I-Beam Clamp
fig. 228 — safe loads: up to 11,500 lb

concrete inserts

C-B Universal Concrete Insert
fig. 282
$\frac{3}{8}$ to $\frac{7}{8}$-in. rod

C-B Junior Concrete Insert
fig. 279
$\frac{3}{8}$ to $\frac{1}{2}$-in. rod

Screw Concrete Insert
fig. 151
$\frac{3}{8}$ to $\frac{7}{8}$-in. rod

Expansion Case Closed Back Type
fig. 117
$\frac{1}{4}$ to 1-in. rod

Write for Hanger Catalog 10D

GRINNELL

WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago
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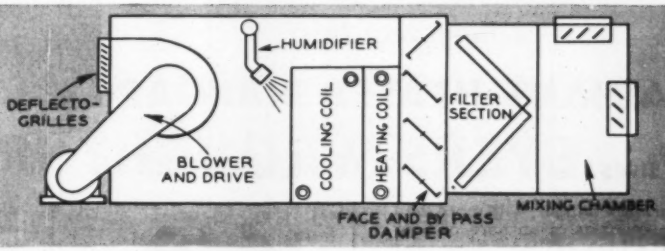
Tools of Air Conditioning

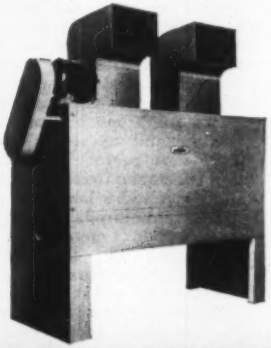
JOB IDEAS BY **usAIRco**

UNIT AIR CONDITIONER: for Industrial and Commercial Application

Units for year-round air conditioning or for any combination of air conditioning functions. Basic unit consists of fan section with cooling and/or heating coils. Filter sections, mixing chambers and dampers, humidifiers, face and by-pass dampers may be added as application requires. Built in ceiling and floor models in 9 standard sizes from 1000 CFM to 12,000 CFM. These packaged units provide efficient, low cost air conditioning for stores, restaurants, offices, laboratories, industrial plants.

Diagram shows unit equipped to do a year-round air conditioning job of cooling, heating, filtering, ventilating, and humidity control.





BLOWER TYPE UNIT HEATER: for Heating Large Volumes of Air

Designed for wide application in factories, warehouses, garages. Can be used in any one of four positions: for floor, ceiling, inverted or wall mounting. Units built in sections for easy handling, installation, maintenance. Available with standard steam or steam distributing tube coils in any one of five capacity series. Standard unit consists of blower section, coil section, and accessories as required including filters, mixing chambers and face and by-pass dampers. Built in eight sizes from 37,500 Btu to 1,995,000 Btu per hour.

usAIRco
Everything In Air Conditioning

United States Air Conditioning Corp.
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Please send your descriptive bulletin on the "Tools of Air Conditioning."

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Address_____

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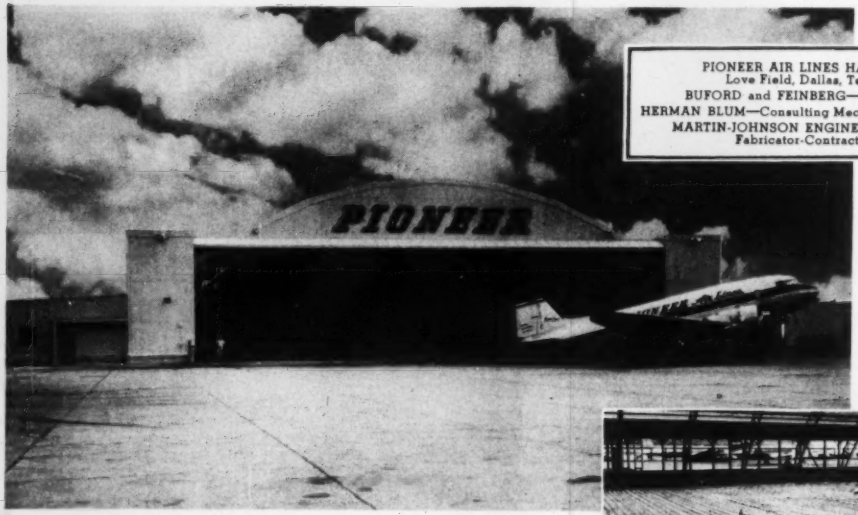
City_____ Zone_____ State_____



PIONEER AIR LINES HANGAR
Love Field, Dallas, Texas
BUFORD and FEINBERG—Architects
HERMAN BLUM—Consulting Mechanical Engineer
MARTIN-JOHNSON ENGINEERING CO.
Fabricator-Contractor

For Maintenance-
ceiling-zero, this

RADIANT HEATED HANGAR

uses BYERS WROUGHT IRON PIPE

In this new hangar, with more than three-quarters of an acre of floor area, a high vaulted ceiling, and large, frequently-opened access doors, the job of maintaining proper temperatures for both personnel and planes presented a difficult heating problem. The designers solved it with radiant heating. And to safeguard the heating system against excessive maintenance and premature replacement, they specified wrought iron pipe.

More than 20 tons of Byers Wrought Iron pipe was embedded in the concrete floor. Hot water, circulating through the pipes, heats the concrete which radiates ample warmth through the hangar. A portion of the installation is shown above.

The designers followed sound proven practice by specifying wrought iron. This material has long been the first choice of experienced engineers because of its unusual combination of advantages. It is readily formed and welded which speeds and simplifies installation. Its emission rate is high. It expands and contracts at practically identical rates with concrete, banning the danger of thermal cracks and loss of bond. It has ample mechanical strength to withstand damage during the installation period. And its corrosion resistance under similar operating conditions has been demonstrated in hundreds of installations, over periods of many years.

Our bulletin, "Byers Wrought Iron for Radiant Heating" gives the complete story. Ask for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N.Y.

WHY WROUGHT IRON LASTS

This notch-fracture test specimen illustrates the unusual fibrous structure of wrought iron—which is responsible for the unusual corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Heating Piping & Air Conditioning

(with which is merged the Aerologist)

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150 lbs. W.O.G.
Available in globe type, with or without waste, angle type also available.

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O-B *Composition Disc* Globes and Angles shut off with a smooth, non-grinding action that lessens disc damage and guarantees better valve performance.

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To insure complete customer satisfaction, buy O-B composition disc valves for your next plumbing or heating job. A full line of globes and angles with either screw-type or solder-type ends is available from your local Ohio Brass Company distributor. See him for any of your plumbing and heating supplies.

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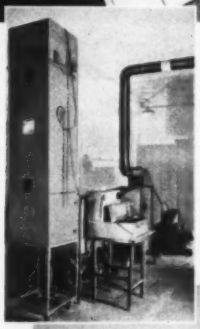
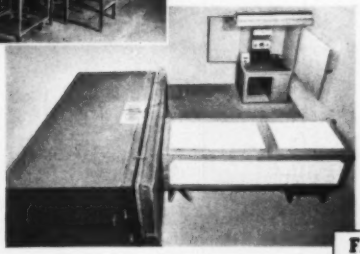


Views of laboratory facilities available to you at the Farr Company



Farr Company Engineers offer complete laboratory services to bring you better air filtration . . .

Your air conditioning system deserves the best in air filters and standard FAR-AIR® filters will meet most of your requirements. However, if you are faced with unusual dust conditions, Farr Company's well-equipped laboratory will help you select the proper type of filter to meet your particular problem.

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Send in your air filtering problem today or write for information on the complete FAR-AIR line.

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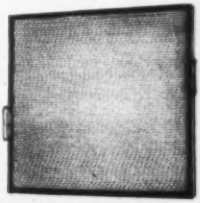

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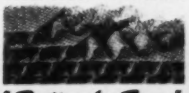

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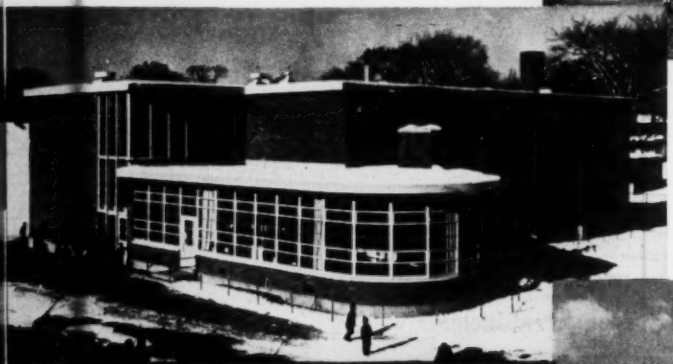
Many 25 to 40 year old installations still giving dependable regulation
. . . . . these and many other plus values in POWERS systems of temperature control give users more for their money

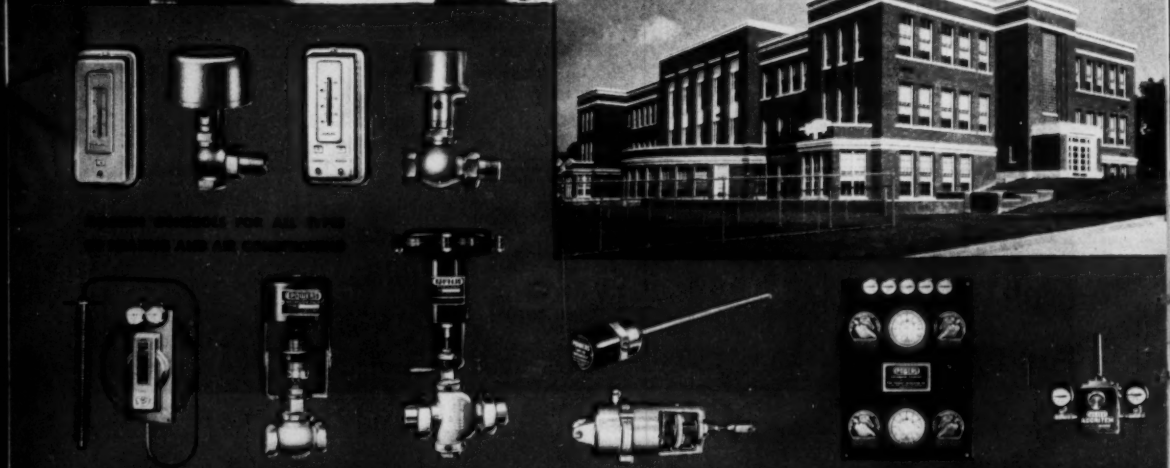
Above: Greenbriar School, Northbrook, Ill.
Architects-Engineers: Perkins & Will, Chicago—Mechanical Engineer: E. R. Gritschke—Heating Contractor: Northern Plumbing & Heating Co., Chicago

Right: Elm Hill School, Springfield, Vt.
Architect: Richard D. Butterfield, Perkinsville, Vt.—Engineer: Thomas Tash, Hanover, N. H.—Heating Contractor: Dezero & Randall, Rutland, Vt.



Left: Elementary School and Shop Bldg., Brewer, Me.
Architect & Engineer: Alonzo J. Harriman, Auburn, Me.—Heating Contractor: C. H. Babb & Co., Bangor, Me.

Below: North Norwood School, Norwood, Ohio.
Architect: Charles F. Cellarius, Cincinnati, Ohio—Engineers: Fosdick & Hilmer, Cincinnati, Ohio—Heating Contractor: B. & J. Jacobs Co.



Above: Carle Place Elementary School, North Hempstead, L. I., N. Y.

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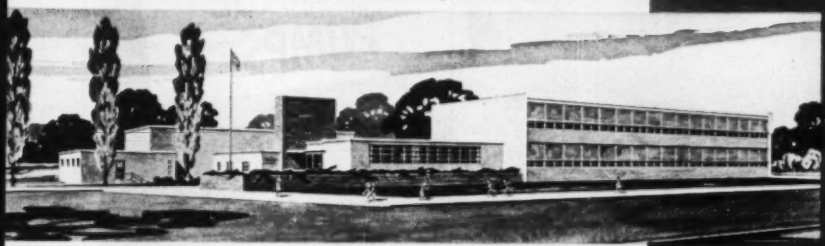

Above: Porter School, Prairie Village, Johnson County, Kans.

POWERS

Above: Conway School, Ladue, St. Louis County, Mo.

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Above: Sidney Lanier School, Dallas, Texas.

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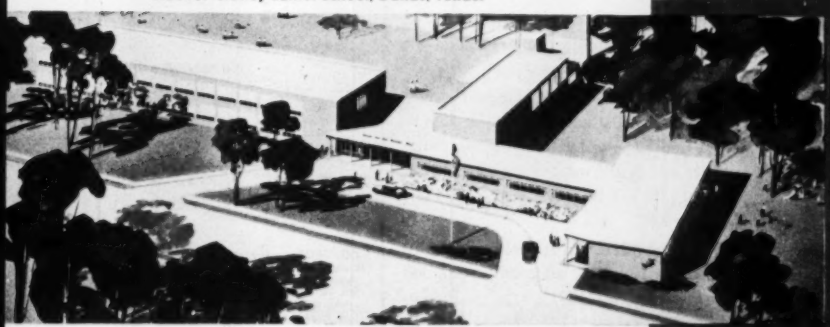

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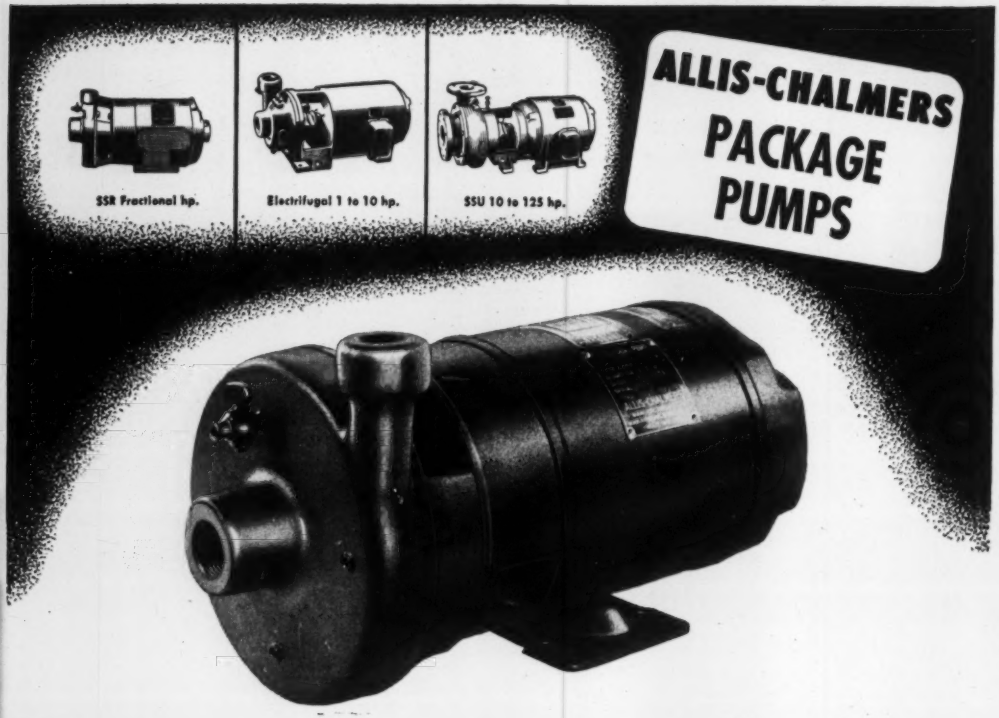

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WHEN YOU CHOOSE an Allis-Chalmers pump for your air conditioning equipment or installation, the Allis-Chalmers representative goes over the complete installation with you to make sure that you get exactly the pump you need for easy installation and customer satisfaction.

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Call in the Allis-Chalmers representative while you are planning your equipment or installation. He may be able to save you time and money by suggesting easier and better ways to install pump or piping. He will be glad to help you in any way he can.

For complete information on Allis-Chalmers pump for air conditioning, ask for Bulletin 52B7529. A-3221

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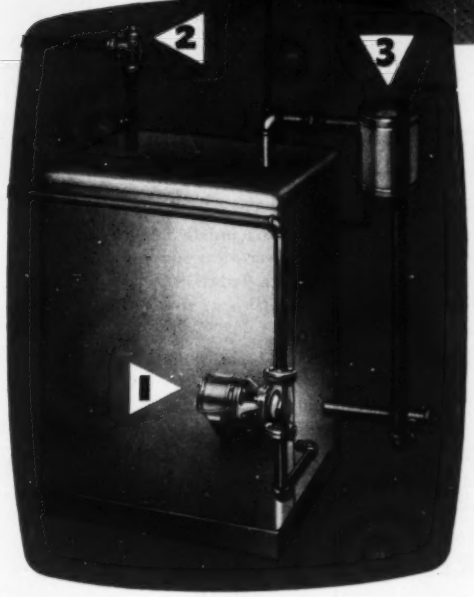
WITH RADIANT BASEBOARDS

FOR RADIANT SUNNY WARMTH AND BEAUTY TOO



THREE GREAT COMFORT-ECONOMY FEATURES!

WARMTH AS SOOTHING AS SUNSHINE

YEAR 'ROUND HOT WATER

LOW OPERATING COST

No wonder this combination for winter comfort and home beauty is being installed in so many new homes!

Consider these features: Radiant sunny warmth from heating units which look like conventional wooden baseboards *and are just as unobtrusive!* No over or under-heating—the B & G *Hydro-Flo* System automatically adjusts the heat supply to the weather! Heat is evenly distributed—draftless—virtually the same temperature from floor to ceiling!

Next, an all year 'round supply of hot water for kitchen, laundry and bath, *heated by the same boiler that heats the house.* Plenty for automatic washers, showers—and at amazingly low cost!

And finally—fuel economy! The automatic modulation of the heat supply prevents fuel waste—keeps heating cost at rock bottom. This accurate control is especially valuable in spring and fall, when only a little heat is needed.

Write for descriptive literature.

B & G *Hydro-Flo* Equipment can be installed on any hot water heating boiler

1. *B & G Booster*—An electrically operated pump which circulates hot water through the baseboards.
2. *B & G Flo-Control Valve*—Helps keep home temperature constantly at the comfort level.
3. *B & G Water Heater*—Provides an abundance of year 'round, low-cost hot water.

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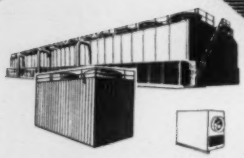
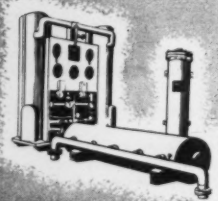
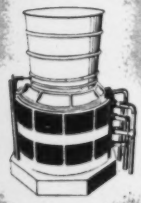


COOLING TOWERS



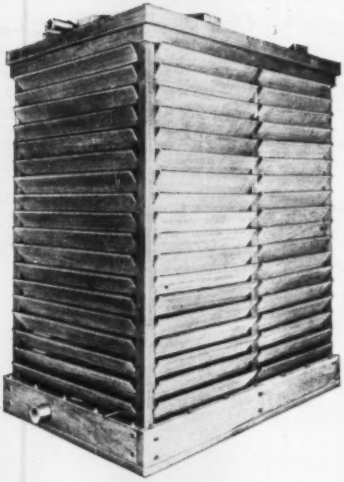
GAS EQUIPMENT



AIR COOLED HEAT EXCHANGERS

Producers of QUALITY Specialized Process EQUIPMENT

WATER CONSERVATION AT WORK



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You'll Want to Specify *The* Pritchard "SRF" TOWER!

Low cost Pritchard Series "SRF" Cooling Towers are especially designed for air conditioning or refrigerating installations requiring 3 to 24 tons capacity. Louver boards, louver posts and top framing are made of finest California Clear-Heart Redwood for *long life.* Steel pipe distribution system assures efficient, *trouble-free* performance.

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For lowest initial cost, longest life, greatest efficiency, specify and install the Pritchard "SRF" Tower! Your inquiry invited.

Write for *FREE* Bulletin No. 5.9.081

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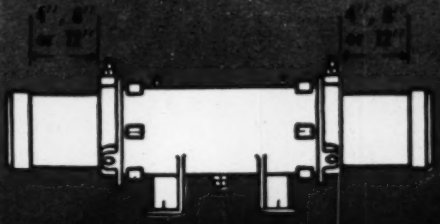
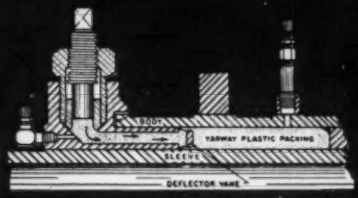
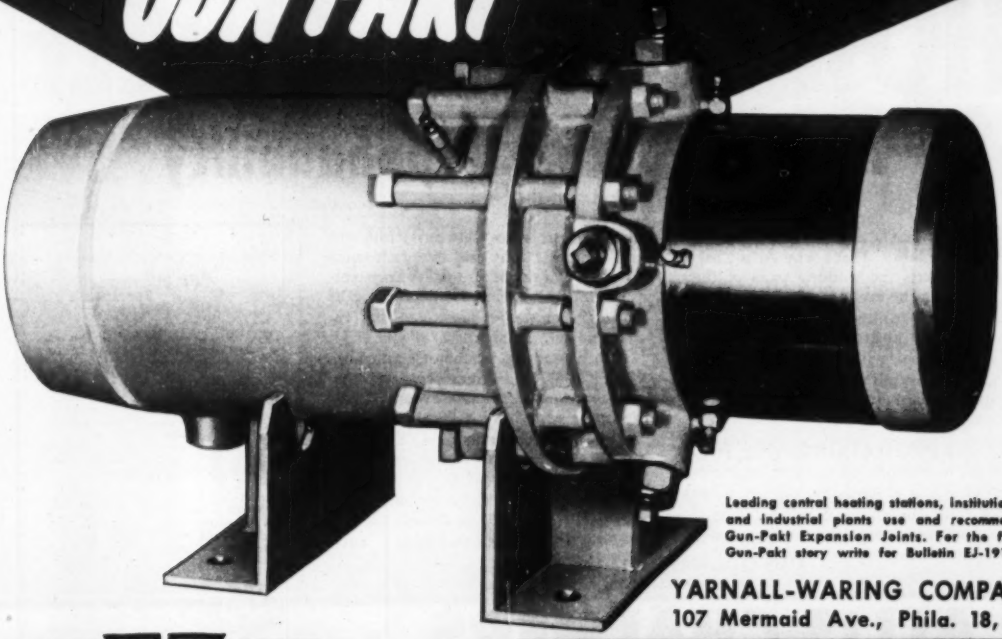


AND LESS MAINTENANCE



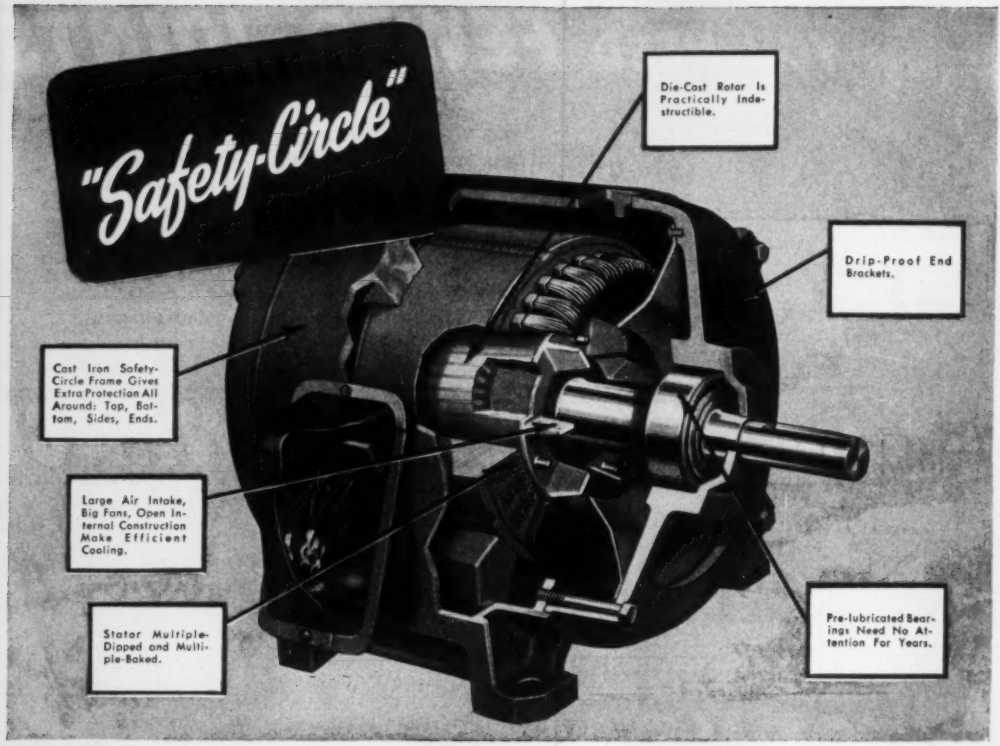
W... GUN-PAKT ...ints



Leading central heating stations, institutions and industrial plants use and *recommend* Gun-Pakt Expansion Joints. For the full Gun-Pakt story write for Bulletin EJ-1912.

YARNALL-WARING COMPANY
107 Mermaid Ave., Phila. 18, Pa.

YARWAY GUN-PAKT EXPANSION JOINT


"Safety-Circle"
Die-Cast Rotor Is Practically Indestructible.
Drip-Proof End Brackets.
Cast Iron Safety-Circle Frame Gives Extra Protection All Around: Top, Bottom, Sides, Ends.
Large Air Intake, Big Fans, Open Internal Construction Make Efficient Cooling.
Stator Multiple-Dipped and Multiple-Baked.
Pre-lubricated Bearings Need No Attention For Years.

HOW SAFETY-CIRCLE

Means Motor Dependability

EXTRA PROTECTION means extra dependability. That's why Allis-Chalmers protects the working parts of the motor with the exclusive *SAFETY-CIRCLE*. Compare this motor with motors of less rigid construction. The *SAFETY-CIRCLE* motor will not distort in mounting or under strain. And you get the extra protection of drip-proof end brackets at no premium.

EXTRA PROTECTION INSIDE, TOO

Stator is multiple-dipped and multiple-baked in special insulating varnish. Rotor is die-cast aluminum. Stator is mounted in four longitudinal ribs which leaves plenty of air space between stator and frame. Large fans cast integrally with the rotor and ample air intakes keep temperatures well within rated limits. *Ball bearings are factory-lubricated and require no further attention for years.*

When you shop for motors, remember *SAFETY-CIRCLE* gives you *extra protection, extra dependability* and *lower operating costs.*

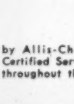
For details on *SAFETY-CIRCLE* advantages, see your A-C Authorized Dealer or Sales Office or write for Bulletin 51B6210B. Sizes 1 to 20 hp, 326 frames and smaller. *Safety-Circle, Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks. A-3146

ALLIS-CHALMERS, 1171A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

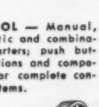
Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

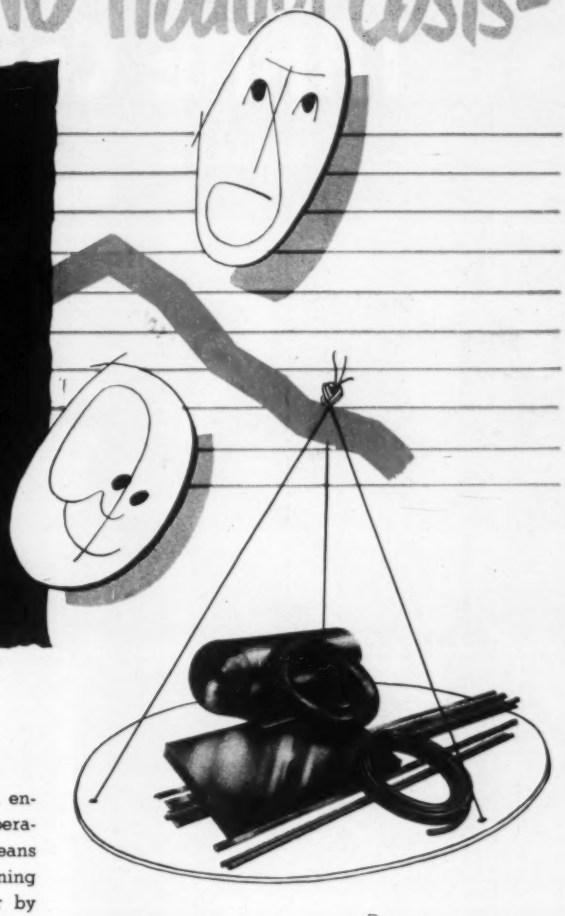
TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.



PUMPS — Integral motor and coupled types from ⅜ in. to 72 in. discharge and up.

Offset RISING Product Costs-

REDUCE
PRODUCTION STEPS
WITH
EASY-TO-FABRICATE
HUSSEY COPPER



Low Cost - Easy to Use

Hussey Copper is a *versatile* metal . . . enabling faster production, with fewer operations in innumerable applications. It means easy forming, stamping, turning or spinning . . . and simplified fastening, whether by soldering, brazing, riveting, crimping, bolting or screwing—even by lamination to other materials.

Hussey Copper is a material well worth investigating in the light of rising product costs.

Permanence and Beauty add Sale-ability!

Added advantages of designing with Hussey Copper are lifetime durability, and a lasting, natural beauty recognized the world over as a symbol of quality. Such ready acceptance makes your selling job all the easier.

Compare the metals and compare the costs . . . see how Hussey Copper serves *your* needs best.

HUSSEY

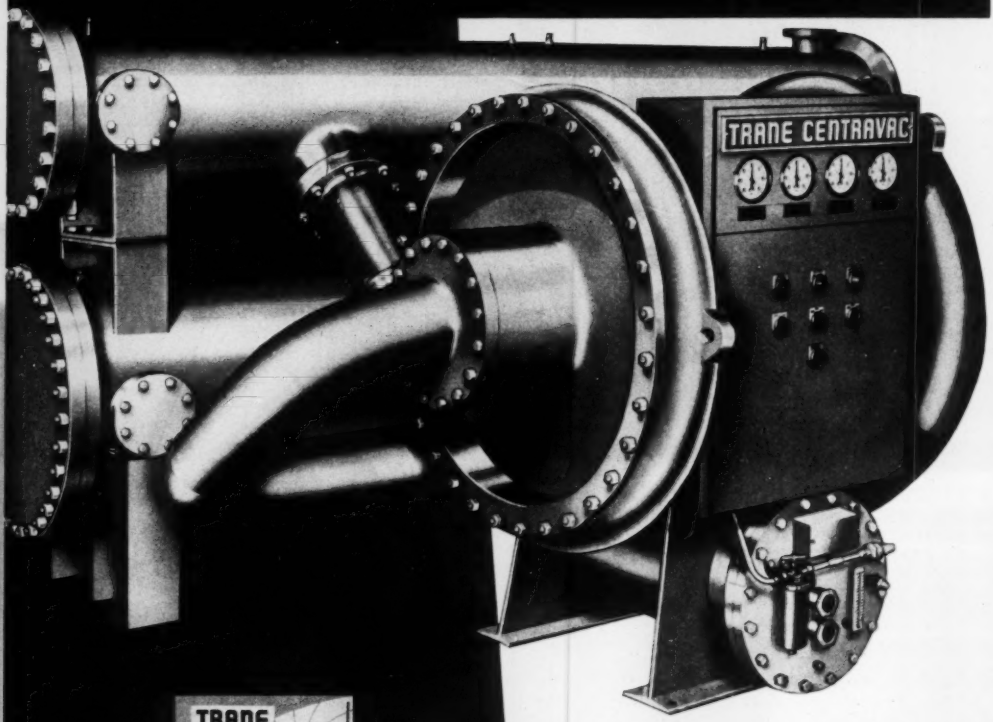
C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES: PITTSBURGH, PA.
Hussey Warehouses carry stocks of Copper and Brass Products for Prompt Shipment

7 convenient warehouses to serve you promptly!

PITTSBURGH, 2850 Second Avenue • CLEVELAND, 5318 St. Clair Avenue • NEW YORK, 140 Sixth Avenue • CHICAGO, 3900 N. Elston Avenue • ST. LOUIS, 1620 Delmar Boulevard • PHILADELPHIA, 1632 Fairmount Avenue • CINCINNATI, 424 Commercial Square

HERE'S THE NEW

TRANE CenTraVac...



One installation, one wiring job, one set of controls . . . one machine is a complete refrigeration system.

Now . . . better-than-ever results from the systems you design or install . . . with a CenTraVac, the completely new Trane Centrifugal Refrigeration Unit.

Now . . . for the first time . . . a centrifugal design engineered for practical air conditioning and process cooling requirements with models ranging in capacity from 45 to 190 tons of refrigeration.

Flexible capacity control, proportionate power reduction, hermetically sealed construction—these exclusive features are only a few of the outstanding basic improvements available only in the great new Trane CenTraVac Centrifugal Refrigeration Units.

For complete literature and full information contact the Trane Field Representative in your area or write to The Trane Company, La Crosse, Wisconsin, for Bulletin S-399.

MANUFACTURING ENGINEERS OF HEATING

it's more than a compressor!

Complete centrifugal refrigeration unit cuts costs four ways

For the first time, a centrifugal unit furnishes chilled water for installations as low as 45 tons! The CenTraVac is the only centrifugal designed for smaller jobs as well as the bigger ones. A new kind of centrifugal—with hermetically sealed direct drive—with stable operation from 100% down to 10% of rated capacity—with reduced power consumption under reduced capacity operation.

Big Power Savings On Jobs As Low As 45 Tons!

When less cooling is demanded by the system, the CenTraVac automatically lowers capacity. Horsepower per ton reduction parallels capacity reduction over wide operating ranges. Owner pays only for cooling actually used by the system, thanks to CenTraVac built-in capacity control and the new Trane power reduction feature.

Simplified Installation Slashes Costs!

Compact, lightweight CenTraVac can be located conveniently in building without special mounting foundations. Smooth running, quiet operation eliminates need for isolation. Then, too, *one* wiring job, *one* set of connections, *one* system of controls is all that is required. The CenTraVac is a hermetically sealed unit containing the compressor, the condenser and the evaporator for the complete chilled water system!

Maintenance Time and Expense Eliminated!

The CenTraVac is designed to run without special attention. Impellers mounted directly on shaft of water-cooled, hermetically enclosed motor eliminate troublesome shaft seals, gear boxes, unnecessary bearings. Forced-feed oil system is designed for positive lubrication of two main bearings, the only bearings in the entire machine. Turn it on, turn it off, as often as necessary, or let it run continuously season after season.

High Efficiency Means Low Cost Cooling!

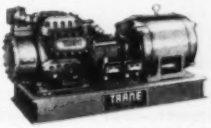
Less than one horsepower per ton required for usual air conditioning applications! Under varying loads the tonnage-to-horsepower ratio often averages out even more favorably.

The CenTraVac supplies lowest cost chilled water for smaller jobs as well as big ones. Five models to choose from between 45 and 190 tons!

This great new Trane line makes centrifugal refrigeration available—
for the first time—in the capacities required for the majority
of practical air conditioning and process cooling applications!

AND AIR CONDITIONING EQUIPMENT • OFFICES IN 80 CITIES

New Trane Self-Contained Air Conditioner! Brand new design packs greater capacity into small cubic space, produces more cooling, yet occupies less floor area. See new Trane Bulletin S-362.



The Brand-New, All-New Trane Reciprocating Compressor. Higher efficiency . . . smoother running . . . longer lasting . . . here's a new Trane-designed and Trane-built refrigerating unit for 10- to 30-ton jobs. See bulletin DS-361.

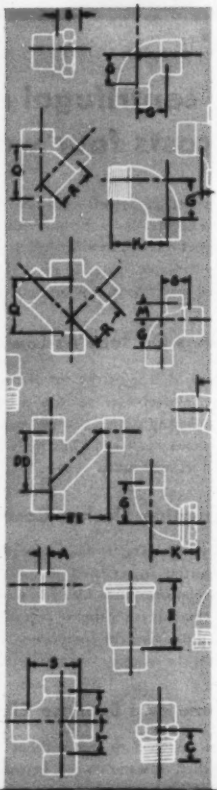
Choose Trane and Choose Your Own Weather! Each guest at Continental Hotel, Miami Beach, Florida, can choose his own weather because management wisely chose *UniTrane Air Conditioning* . . . complete systems like this, with individual room weather control, are easier than ever to design and install with Trane's bigger, better 1951 line of products.

TRANE

THE TRANE COMPANY, LA CROSSE, WISCONSIN
EASTERN MFG. DIVISION • SCRANTON, PA.
TRANE COMPANY OF CANADA, LTD., TORONTO

How to install better piping

COPPER makes a rough-in smooth

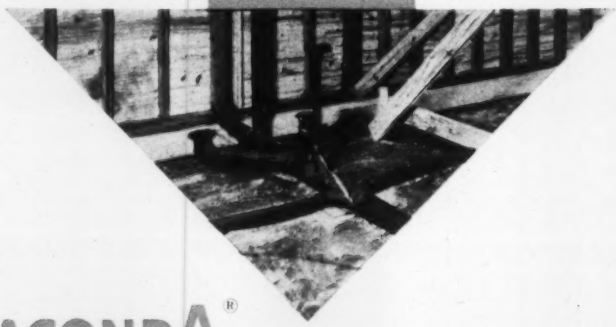


Literally, there's nothing like ANACONDA Type M Copper Tubes and solder type drainage fittings for fast and easy installation of soil, waste and vent lines. You'll recognize why from these important features:

- **Solder joints are faster and more simple than threaded connections; easier to make in restricted places.**
- **Tubes and compact fittings can be installed in standard width partitions.**
- **Twenty-foot tube length reduces number of joints.**
- **Light weight permits easy installation of shop-fabricated assemblies. An all-copper system weighs only about one quarter as much as one of cast iron and steel.**

5104

There's a complete line of solder type drainage fittings for every size and kind of connection — as well as a complete line of solder type water fittings for water supply and low pressure heating lines. For complete information, just write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.



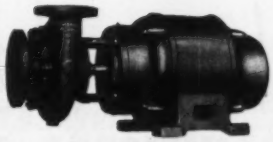
nothing serves like

ANACONDA®

COPPER TUBES

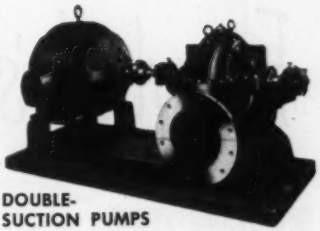
LEAD - ACID AND OTHER CHEMICAL PUMPS

"Buffalo" Chemical Pumps are available with lead lining like the pump shown, or rubber lined or of special alloys. Bulletin 982.



CLOSE-COUPLED PUMPS

A real space-saving design with no sacrifice in durability and efficiency. For clear water, but can be had in special alloys. Bulletin 975-B.

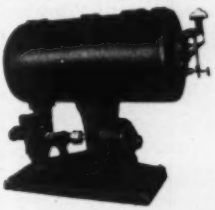


DOUBLE-SUCTION PUMPS

For top performance on clear water jobs, including air washers, these are of the finest materials and construction. Bulletin 955-N.

PAPER STOCK PUMPS

Diagonally-split-shell non-clogging pumps. A design for every liquid, every consistency, all proven in paper and pulp mills. Bulletin 953-F.



AUTOMATIC CONDENSATE PUMPS AND RECEIVERS

Will handle condensate at 212° F. without being affected in any way. Self-priming and trouble-proof. Bulletin 960-G.

SUMP PUMPS

Self-contained vertical units ready to install. Rugged, trouble-free, with ball-bearing thrust and enclosed shaft. Bulletin 963-F.

NON-CLOGGING SEWAGE PUMPS

Vertical and horizontal models for trouble-free operation in sludge circulation, agitation and removal, in lift stations and treatment plants. Bulletin 964-D.

"Buffalo" PUMPS

MEAN MONEY SAVED THROUGH TROUBLE AVOIDED

True economy in pumping is in the pump you can install — and practically forget! "Buffalo" has always built such pumps. First cost may be a few dollars more than the "low-bidder" pump, but careful, sound "Buffalo" design and construction has always paid for itself in (1) longer years on the job, (2) fewer and shorter shutdowns, and (3) high efficiency.

As the pictures on this page show, you can pick a "Buffalo" Centrifugal Pump that's tailor-made for just about any liquid job you have. WRITE FOR BULLETINS!

BUFFALO PUMPS, INC.

171 MORTIMER STREET BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities

— And For FANS . . .

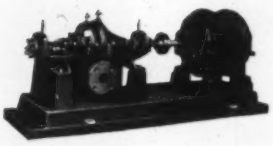
. . . you'll find a full line of centrifugal, axial flow and propeller fans in the sizes and arrangements you want — a fan for every job! For best results on your next fan installation, look to "Buffalo". . . First For Fans. For complete information, write:

BUFFALO FORGE COMPANY

171 MORTIMER STREET BUFFALO, N. Y.

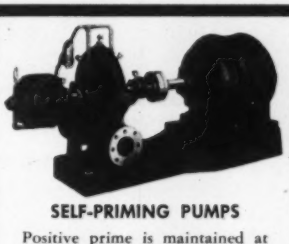
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities



TYPE "RR" PUMPS

For handling clear water, any temperature, at high pressures. Widely used for boiler feed. Rugged, efficient. Bulletin 980-B.



SELF-PRIMING PUMPS

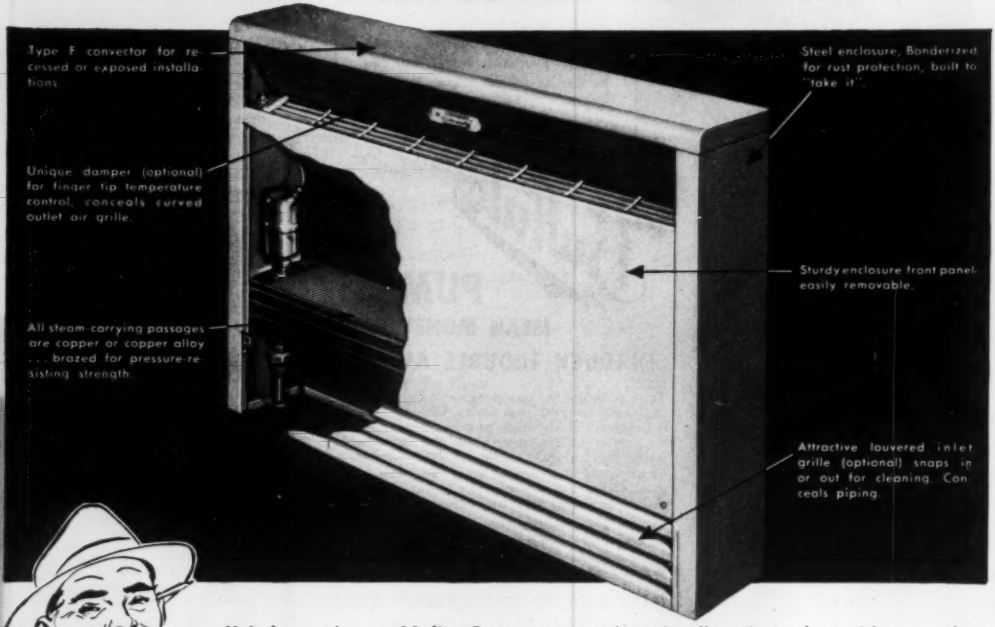
Positive prime is maintained at all times. A popular feature available in all "Buffalo" Double Suction Pumps. Bulletin 970-A.

SPECIAL ALLOY PUMPS

Single suction, full ball bearing pumps, suitable for construction in most machineable alloys. Bulletin 982.

Everybody's happy when you select

MODINE CONVECTOR RADIATION


Type F convector for recessed or exposed installations.
Unique damper (optional) for finger tip temperature control, conceals curved outlet air grille.
All steam-carrying passages are copper or copper alloy . . . brazed for pressure-resisting strength.
Steel enclosure, Bonderized for rust protection, built to "take it".
Sturdy enclosure front panel easily removable.
Attractive louvered inlet grille (optional) snaps in or out for cleaning. Conceals piping.

He's happy because Modine Convectors are easier to install . . . time and material costs are less. Individually cartoned, they weigh only ¼ as much as cast iron radiators. Square enclosure corners simplify recessing. Universal headers and adjustable-pitch heating unit brackets speed piping connections. On any type or size of job, he profits most when he installs Modines.

She's happy because Modine Convectors are so easy to clean. Dust can't get a foothold! Optional snap-in lower grille instantly removable for cleaning. For major seasonal sprucing up, front panel can be removed in a jiffy.

He's happy he specified Modine. Giving his client the benefit of blended radiant and convection heat plus the beauty, convenience, durability and proved economy of Modine Convectors was a case of excellent judgment.

She's happy . . . as any decorator would be . . . when Modines are selected. Their functional styling permits complete freedom of room treatment. Recessed under windows, Modines use no floor space . . . are never a decorative problem.

R-1086

For new catalog, call your Modine representative —listed in your phone book classified section.
Or write Modine Mfg. Co., **1509 Dekoven Ave., Racine, Wisconsin.**

Modine CONVECTOR RADIATION

The heating system has changed...

but the name on the pipe is the same...

SPANG CW

When you're planning and laying-out radiant heating systems, be sure to specify "Steel Pipe" . . . and to be sure of top-quality, specify "Spang CW Steel Pipe".

You'll like working with Spang CW Steel Pipe. It's uniform in quality, mill-tested, easy to cut, bend and weld. It's strong to withstand mechanical pressure, and rough handling. It stands up for a lifetime in closed-circuit systems.

Even when wet-system central heating was a novelty, Spang was a famous name in pipe . . . it's been famous for 110 years.

And today's great demand for Spang CW Steel Pipe . . . greatest in our long history . . . makes it difficult for your supply house to fill all orders as quickly as they'd like to. But keep in touch with them . . . you can depend on them to do their best for you.

SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICE: Grant Bldg., Pittsburgh, Pa.

District Sales Offices: Atlanta; Boston; Detroit; Houston; Los Angeles; New York; Philadelphia; Pittsburgh; St. Louis

SPANG

STEEL PIPE

QUALITY

that is recognized wherever pipe is used

New, higher standards of comfort demand **MORE EFFICIENT HEATING**

KEWANEE
STEEL BOILERS

in McKeesport

IT'S KEWANEE

Technical High School
3—Kewanee—Type "C"
George Washington School
2—Kewanee—Type "C"
St. Peter's High School
2—Kewanee—5000's
Swift & Co. Warehouse
1—Kewanee—Type "C"
Vienna Baking Co.
1—Kewanee—Type "C"
Penn-McKee Hotel
1—Kewanee "K"

● To keep pace with modern ideas in planning and new, better standards of comfort which demand higher efficiency from heating systems, an ever increasing proportion of America's schools are using Kewanee Boilers.

The McKeesport Vocational High School, McKeesport, Penna., an outstanding example of today's modern schools, is equipped with 3 Kewanee Type "C" Boilers for stoker firing, with a total steam capacity of 22,000,000 Btu hourly.

McKeesport Vocational High School
McKeesport, Penna.

C. R. Moffit, McKeesport, Architect
F. J. Firsching, Pittsburgh, Engineer
The Withers Co., New Castle, Htg. Engineers

KEWANEE BOILER CORPORATION

BOILERMAKERS 80 YEARS KEWANEE, ILLINOIS
Branches in 60 Cities—Eastern District Office: 40 West 40th Street, New York City 18
Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

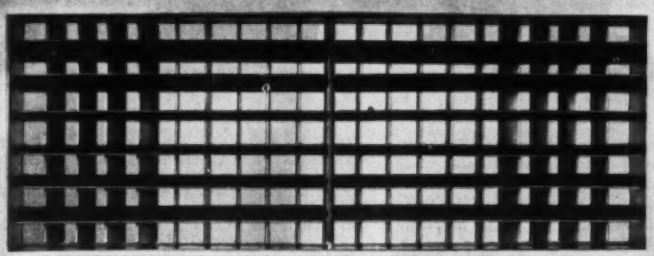
Serving home and industry

AMERICAN STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

A LOT MORE PERFORMANCE FOR A LOT LESS MONEY

Air Foil

Compare these unbeatable low cost
LIST PRICES
12 x 6 - - $3.40
14 x 6 - - $3.75
24 x 6 - - $5.35



THE ABSOLUTE ULTIMATE IN SUPER EFFICIENT AIR DIFFUSION

A NEW, LOW-COST AIR CONDITIONING GRILLE. You've wanted it — now you've got it. The Titus Airfoil No. 270 combines all the exclusive superior features of the famous Titus Airfoil Grilles and gives them to you in this great new grille AT A NEW LOW PRICE.

The new Titus Airfoil No. 270 has been time tested and proven after years of research. It also features the Airfoil louvre with streamlined, smooth-as-glass, surface, which knifes the air and gives more control than heretofore thought possible.

This amazing new Titus Airfoil No. 270 grille does everything the more expensive grilles do *and Does Them Better!*

BEFORE YOU BID YOUR NEXT JOB, SEND FOR COMPLETE INFORMATION ON THE TITUS AIRFOIL No. 270. You'll be amazed at all the performance features which are incorporated in this grille. They mean so much — YET COST SO LITTLE.

NOTE THESE SPECIAL FEATURES

which give the Titus Airfoil No. 270 unapproachable air diffusion performance

- **Airfoil louvre — designed after the Airfoil section of an airplane.**
- **Solid section louvre construction for noise-free performance.**
- **Streamlined louvre with no sharp corners, no holes, no crevices.**
- **One-piece, extra-heavy frame.**
- **Air-tight rubber gasket to prevent all air leakage.**
- **Two banks of louvres.**
- **Individual blade adjustment.**

Mail This Great Money-Saving Coupon Today!

TITUS MANUFACTURING CORPORATION
WATERLOO, IOWA

Gentlemen: Please rush me complete information including *Prices, Discounts* and *Delivery* on the new Airfoil No. 270.

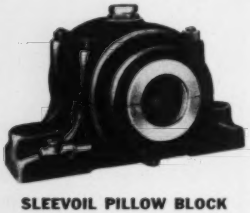
*Name*_____

*Address*_____

*City*_____ *State*_____

QUIET DODGE BEARINGS

THE MOST COMPLETE LINE FOR FAN AND BLOWER SERVICE



SLEEVOIL PILLOW BLOCK

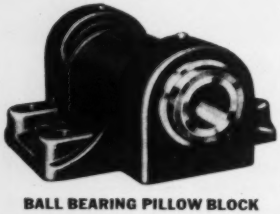
A precision-built, ring-oiling babbitted bearing, self aligning and exceptionally quiet in operation. Special seals prevent oil leakage and keep dirt out of the bearing.

WATER-COOLED SLEEVOIL

Specially designed for applications where elevated temperatures are encountered. Dodge Sleevoil bearings combine quietness with exceptional load carrying capacity; are available in shaft sizes from 1-11/16" to 8".

DODGE BRONZOIL

Capillary bronze bushing has capacity of one-third its volume in oil. Reservoir with close fitting wick around bushing provides ample lubrication. Oil resistant grommets available for noise isolation. Sizes 1/2" to 1-1/4".



BALL BEARING PILLOW BLOCK

Single row, deep groove ball bearings. Inner race extended to form sleeve which carries shaft. Piston ring seals retain lubricant, exclude dirt. For arrangement No. 2, Shaft sizes 15/16" to 2-1/4".

BRONZE BUSHED PILLOW BLOCK

Designed for arrangement No. 2 installations. Two bronze bushings of high lead content and T section rings, sealed against dirt. Composition rings inside thrust collar prevent oil leakage. For shaft sizes 15/16" to 2-3/16".

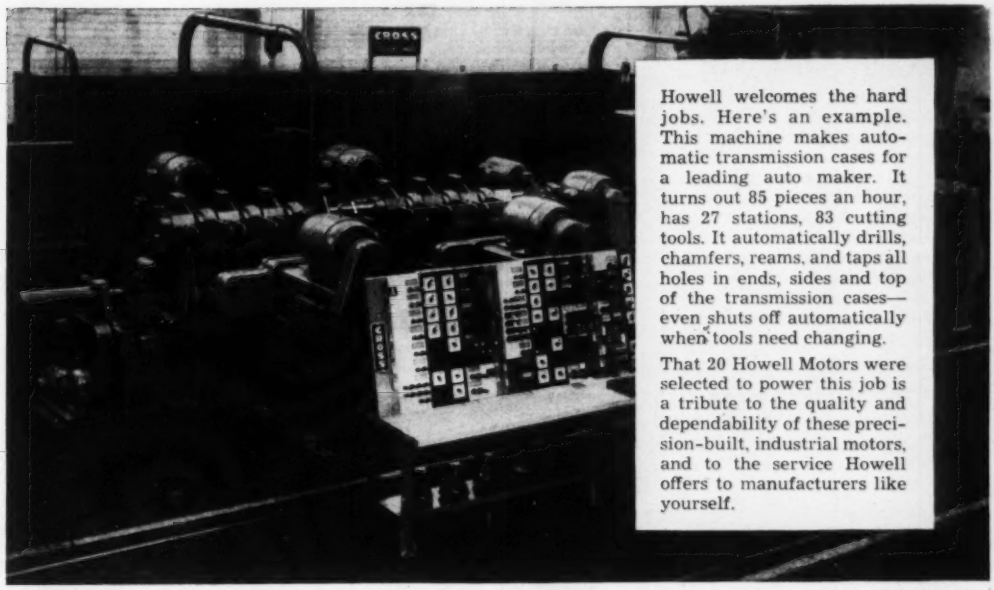
CALL THE
TRANSMISSIONEER
your local Dodge distributor, for information about the entire Dodge line of bearings for fan and blower service. Look for his name in the Classified Telephone Directory under "Power Transmission Equipment." Or write to the factory.

DODGE MANUFACTURING CORPORATION
1600 UNION ST., MISHAWAKA, IND.

DODGE
of Mishawaka, Ind.

FIRST IN POWER TRANSMISSION MACHINERY

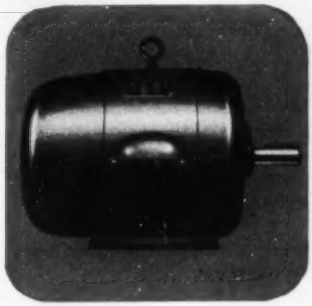
FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
CHICAGO THRIFT ETCHING CORPORATION, 1555 N. SHEFFIELD AVE., CHICAGO, ILLINOIS



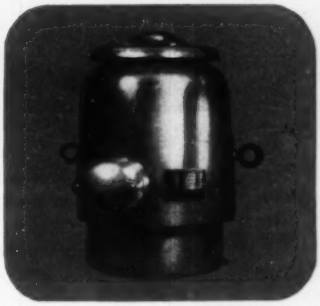
Howell welcomes the hard jobs. Here's an example. This machine makes automatic transmission cases for a leading auto maker. It turns out 85 pieces an hour, has 27 stations, 83 cutting tools. It automatically drills, chamfers, reams, and taps all holes in ends, sides and top of the transmission cases—even shuts off automatically when tools need changing.

That 20 Howell Motors were selected to power this job is a tribute to the quality and dependability of these precision-built, industrial motors, and to the service Howell offers to manufacturers like yourself.

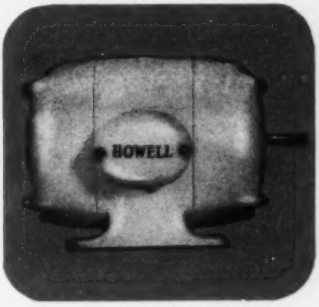
Solution for . . .
THE CASE OF AN AUTOMATIC TRANSMISSION



Howell Type K Motor. Offers constant performance in the presence of dirt, dust, fumes, and moisture. Sizes from 3 to 150 H.P. at 1800 R.P.M. Either vertical or horizontal mounting.



Howell makes specially designed motors—vertical, round body, flange and face mounting, built-in stator and rotor jobs, etc.—to meet a wide range of requirements.



Howell Sanitary Motors meet the most exacting standards of the dairy and food industries. They contain no pockets, cracks, or crevices. Available for vertical or horizontal mounting.

Read this if you need special motors

Howell offers a unique job-engineering service for special motor applications.

With it, you get: (1) cooperation of our engineering personnel; (2) prompt quotations on both standard and custom motors; and (3) the ability to accurately manufacture custom-designed motors within reasonable time.

We believe these services will save you, as a purchaser of electric motors, valuable time and money.

May we apply our facilities and engineering ability to your problem?

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HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Precision-built Industrial Motors Since 1915

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Three and one-half million roses, forty thousand orchids and nearly a million gardenias are grown each year in this huge greenhouse.

Investment in plants and labor is tremendous—losses from even brief chilling would be disastrous.

Detroit RotoStokers Guard Against Loss

Detroit RotoStokers are good protection. These dependable spreader stokers keep up steam without fail.

Available with power, hand-dumping or stationary grates —will burn any type Bituminous coal or Lignite—high efficiency. They have a record for long life, with low maintenance.

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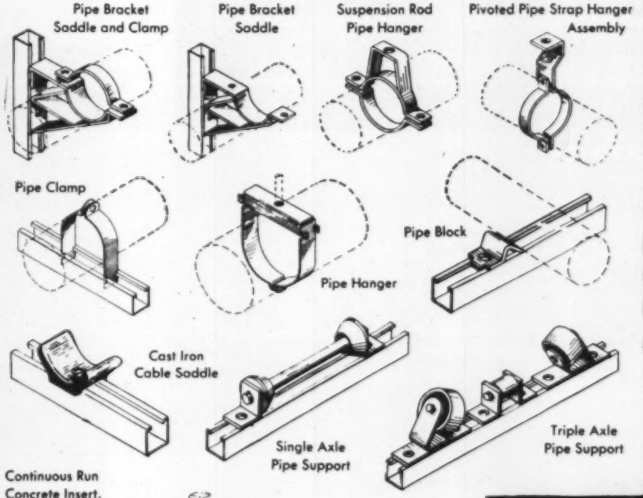
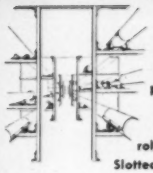
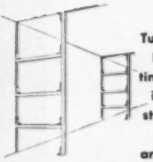
• Unistrut is erected quickly, easily, with a minimum of engineering detailing—permits adjustments, changes or additions on the job or later—assures exact pitch or slope. No drilling, welding, special tools or equipment needed. Unistrut includes metal channel, framing fittings, concrete inserts, clamps, hangers and other standard parts which combine to form the world's most flexible system of support or suspension. Try Unistrut on your next piping job—save time, cut costs.

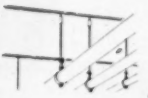

Pipe Bracket Saddle and Clamp
Pipe Bracket Saddle
Suspension Rod Pipe Hanger
Pivoted Pipe Strap Hanger Assembly
Pipe Clamp
Pipe Hanger
Pipe Block
Cast Iron Cable Saddle
Single Axle Pipe Support
Triple Axle Pipe Support
Continuous Run Concrete Insert, 3" to 20' lengths.
Note two kinds of end caps—at left, type A (plain) at right, type B (anchor).
Entrance Anywhere along this Continuous Slot!



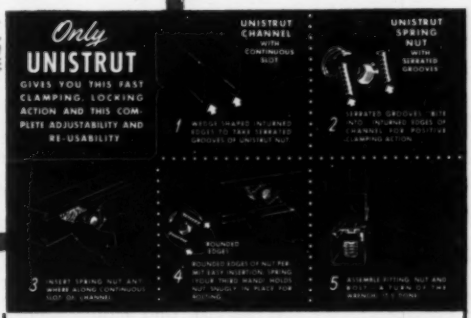
Typical piping installation supported by Unistrut framework, concrete inserts and roller pipe supports. Slotted Unistrut channel permits attachment of fittings at any point desired.



Tunnel job showing how Unistrut continuous run concrete inserts may be installed vertically or horizontally or at any angle required. Attachments made anywhere along slotted channel without disturbing existing connections.



Here are Unistrut continuous run concrete inserts in ceiling, and Unistrut hangers clamped to suspended pipes. For racking heavy overhead pipe runs, Unistrut trapeze assemblies (not illustrated) are ideal.



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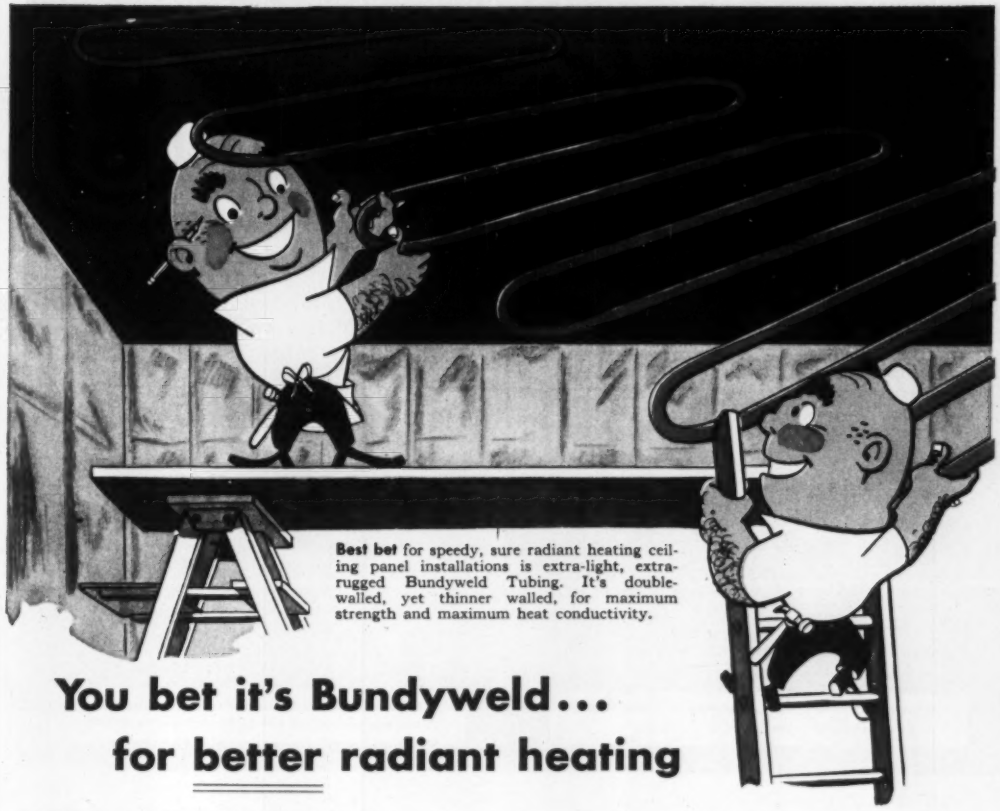

Best bet for speedy, sure radiant heating ceiling panel installations is extra-light, extra-rugged Bundyweld Tubing. It's double-walled, yet thinner walled, for maximum strength and maximum heat conductivity.

You bet it's Bundyweld... for better radiant heating

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SIZES UP TO 5/8" O.D.

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SUPER-7 A AND B BELTS
Strong Cord structure impregnated with live rubber.
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SHOCK RESISTANT — Resilient cushion of rubber, acts as shock absorber, protects cord from stresses.
POWERFUL — Cords are of rayon, firmly twisted, accurately placed, impregnated with rubber to minimize friction.

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SUPER-7 V-belts give long, satisfactory service even under bad conditions of load, shock and grit.

Tough, double-wrapped cover bias cut for elasticity and impregnated with rubber. Effectively seals out dust, grit, moisture; takes the wear; keeps the belt in shape; and protects cord structure.

But you get more than good belts when you standardize on *Super-7* V-belts. You also get the benefit of the greatest V-belt experience in the world both in the field and factory. You are assured of exactly the right drive for longest life from the wide variety of types and sizes available.

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Where space is limited or other special conditions demand heavier duty, the high capacity belt can be furnished in A, B, C, D, and E sections . . . Extra strong cords, special rubber cushion and tough Neoprene cover give them 40% greater capacity than standard belts at proportionately higher price.

V-Belt Drive Headquarters

Your nearby Allis-Chalmers Authorized Dealer or Sales Office can serve all your V-belt needs, whether they be new or replacement V-belts; standard and variable speed sheaves; or speed changers.

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For Pipe Sizes From ½ to 72 Inches

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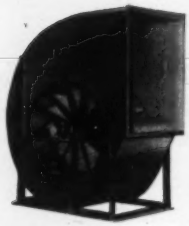

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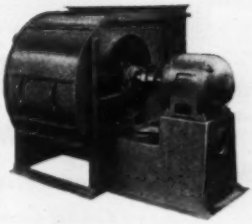

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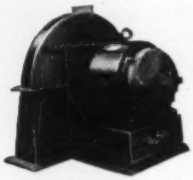

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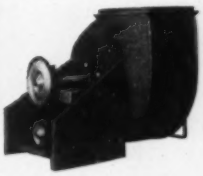

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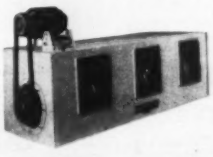

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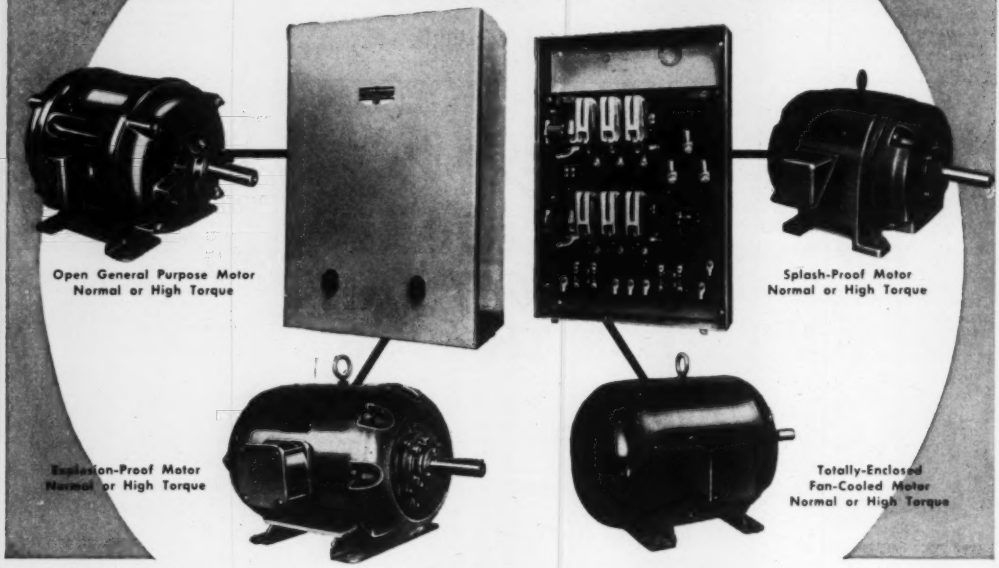

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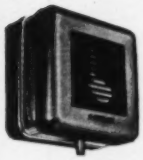

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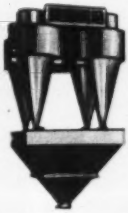

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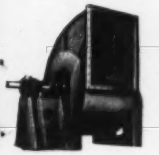

Industrial Fans

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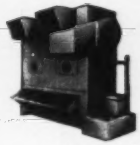

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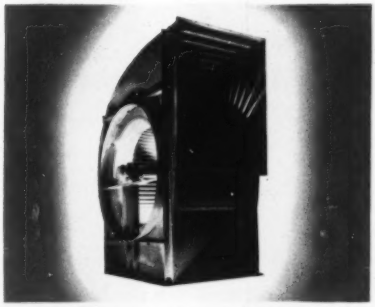

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Sales and Service in the Principal Cities of United States and Canada

Affiliated with Pyrene Manufacturing Company

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT

Squeez-Grip Carbon Dioxide Type Fire Extinguishers • Dry Chemical Type Fire Extinguishers • Built-In Smoke and Heat Fire Detecting Systems Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems

A UNITAIRE CONDITIONER

TO MEET ALL YOUR REQUIREMENTS . . .

. . . for increased worker efficiency or customer comfort.

When you buy or specify the Westinghouse UNITAIRE, it will be:

● **SIZED TO FIT YOUR NEEDS.** The UNITAIRE is available in 2-, 3-, 5- and 7½ horsepower capacities.

● **DEPENDABLE.** You are assured of undivided responsibility for all major parts. The Westinghouse Hermetically-Sealed Compressor has an unequalled performance record in thousands of successful installations.

● **ECONOMICAL.** The elimination of belts, pulleys and shaft seals in the Hermetically-Sealed Compressor design means less maintenance and a longer, trouble-free service life.

● **ADAPTABLE.** The UNITAIRE can be installed alone, in multiples, or with duct systems. The addition of a heating coil provides year 'round air conditioning.

● **EASY TO INSTALL.** All sizes fit through a standard door, and require only water, electrical and drain connections before they are ready to operate.

● **COMPACT.** The largest UNITAIRE needs only a little over 8 square feet of floor space, can be fitted into recessed areas.

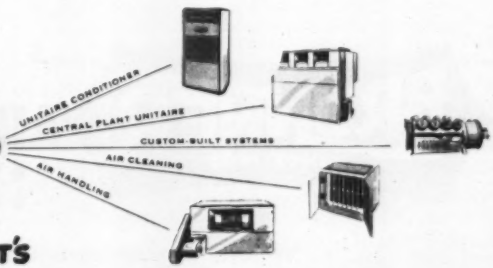
● **QUIET.** The UNITAIRE does not rise above the noise level of an ordinary store or office, and will permit you to shut off outside disturbances by closing doors and windows.

● **ATTRACTIVE.** Modern styling, clean lines and a two-toned gray finish make the UNITAIRE the smartest-looking unit on the market today.

For complete details, call the Westinghouse Air Conditioning Distributor listed in your classified telephone directory, or write Westinghouse Electric Corp., Air Conditioning Division, Hyde Park, Boston 36, Mass.

PUTTING *Air* TO WORK

Only Westinghouse can offer you a *complete* line of air conditioning, air handling and air cleaning equipment.



YOU CAN BE SURE...IF IT'S

Westinghouse

Our dealers are doing business in a big way

WE'LL TELL YOU WHY...

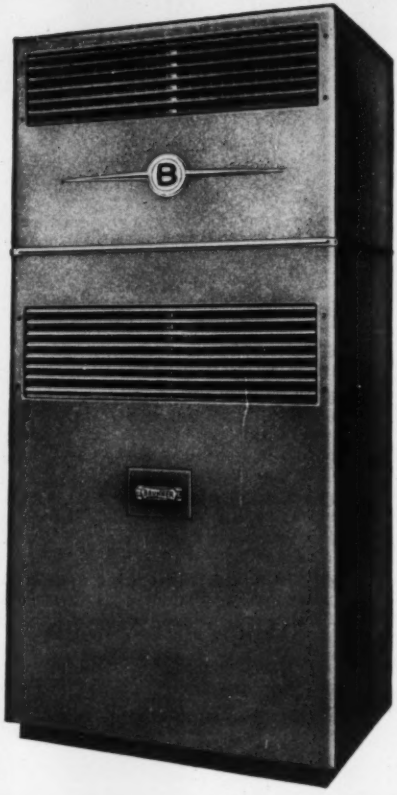
BRUNNER SINCE 1906 AIR CONDITIONING

First of all Brunner Air Conditioning Units, both self contained and remote, are Brunner built. We have absolute control over every point and every design feature that contributes to their maximum efficiency.

Buyers know what they want. Air conditioning is no longer new and in a highly competitive field prospects will choose carefully. Brunner units are built for long, dependable, carefree operation and these qualities are instantly recognized in comparison.

Brunner has customer acceptance. This name is no stranger to folks who buy refrigeration and air conditioning.

Brunner takes care of their dealers. Modern factories, skilled workmen and specialized production lines give you what you want and when you want it.



THERE'S MUCH MORE TO BE TOLD so fill in below and our factory sales engineer will stop by with all the facts of why you could well be sharing in this profitable business. We'll send 1951 literature along at once.

Name

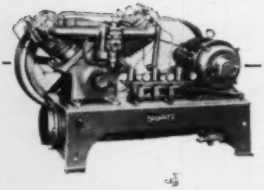
Company

Address

City and State

BRUNNER SINCE 1906 AIR CONDITIONING

- **Self Contained 3 HP. to 10 HP.**
- **Remote Type 3 HP. to 75 HP.**

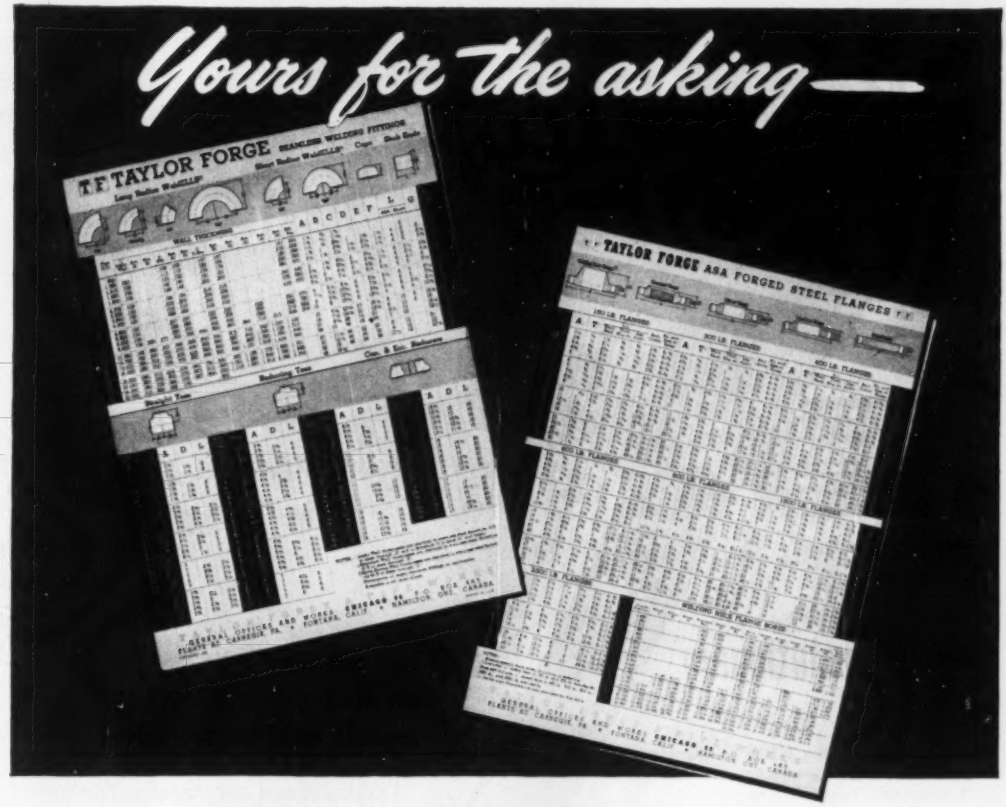


BRUNNER MANUFACTURING CO., Utica 1, New York, U. S. A.

REFRIGERATION CONDENSING UNITS by BRUNNER SINCE 1906

AIR AND WATER COOLED MODELS—*a size and type for every purpose...*¼ **HP. TO 75 HP.**

Yours for the asking—



A VOLUME OF DATA

. . . covering welding fittings and forged steel flanges . . .

ON A SINGLE SHEET

Here is just about the handiest tool ever devised for the pipe designer. Data on welding fittings and flanges that otherwise could be found only by plowing through many catalog pages and tables have been ingeniously condensed on the two sides of the durable letter-size card illustrated above.

One side covers the broad WeldELL line of Taylor Forge welding fittings. For every nominal pipe size, ½" through 30", it shows the wall thickness for every weight of every fitting in every available material. It also shows all required dimensions of all types of fittings.

The other side covers the world's most complete line of forged steel flanges. For every nominal pipe size, ½" through 24", it gives all essential dimensional and bolting data for all types of flanges in all weights. A particularly useful table (see reproduction) is that showing welding neck flange bores which enables you to determine the I.D. of any nominal pipe size without separate calculation. Thus the sheet gives you O.D. and I.D. of any weight of pipe.

The card is varnished to make it stand the steady usage you are certain to give it. To obtain your copy see your Taylor Forge distributor or **MAIL THE COUPON.**

TF

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS

General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities.
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send me one of your fitting and flange sheets.

NAME_____

POSITION_____

COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

510-0251 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

it's New! it's Different!

it's the strongest pipe wrench in the world!

–the revolutionary Walworth improved Walco®

Yes, this is it . . . the NEW Walworth *Improved* Walco pipe wrench–with every part scientifically designed and tested by engineers for strength, safety and ease of operation. Its instant bite, and accurately determined center of gravity, combine with its inherent strength and minimum of weight to make it the fastest-working, easiest-handling, best balanced, heavy-duty pipe wrench available today . . . a wrench specially designed to minimize operator fatigue.

All parts are made of forged steel. The housing and handle are projection welded–a structural weld–to form an integral unit. Both jaws are carefully machined, and all parts are heat-treated to give extra toughness, uniformity, and strength. Every Improved Walco far exceeds the requirements for Federal Specification GGG-W-651a for Type II Heavy Duty Adjustable Pipe Wrenches.

A flexible, double-acting, easily replaceable spring–an exclusive patented Improved Walco feature–gives the wrench fast, positive ratcheting action!

Ask your Walworth distributor about the new, Improved Walco today! Heft the new, Improved Walco . . . feel its perfect balance–every part is guaranteed by the Walworth Company, doing business since 1842.

Check these outstanding features

LIGHTER: Housing and Handle are projection welded to form one integral unit.

CORRECT BALANCE: Accurate, the correct location of the center of gravity determined by test.

STRONGER: Heat treated to eliminate brittleness . . . cracking.

FAST ACTING: Scientifically designed spring action insures positive ratcheting action . . . quick bite.

CALIBRATED PIPE SCALE: Built-in scale permits speedy adjustment to pipe size.

RENEWABLE PARTS: All parts are readily obtainable, and easily replaced without special tools; thus prolonging service life indefinitely.

RUST RESISTANT FINISH: Entire wrench is rust resistant — Nut and Jaws have a special electroplated zinc coating.

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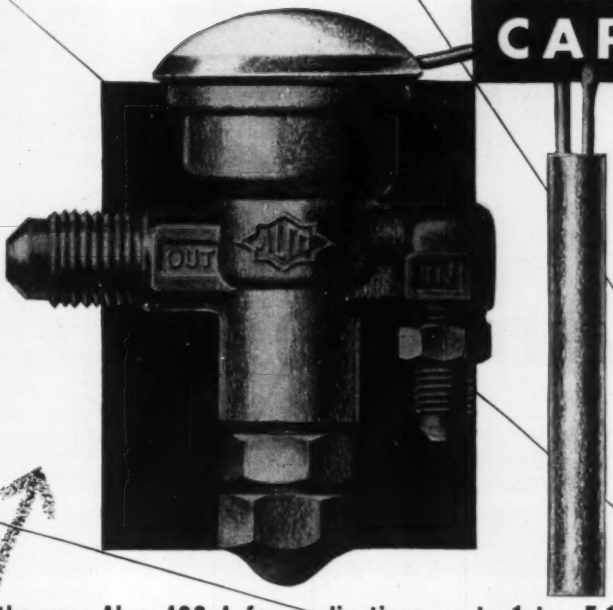
valves...fittings...pipe wrenches

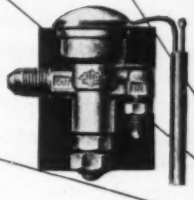
60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

DOUBLED CAPACITY



Same space saving size



402-2 up to ½ ton F12

the new Alco 402-4 for applications up to 1 ton F-12

All of the famous 402 Thermo Valve features—but twice the capacity—up to 1 ton F-12 or 2 tons Methyl Chloride.

LIQUID CHARGE—may be mounted in any position

PRESSURE LIMITING ELEMENT—for motor overload protection

WIDE RANGE SUPERHEAT ADJUSTMENT—2-20°F, easy to set

REVERSE SEATING—smooth action at all loads

REMOVABLE STRAINER—for maximum protection, easy to clean

COMPACT, SIMPLE CONSTRUCTION—minimum of internal parts

See it at your ALCO wholesaler starting in March —try it on your next job.

ALCO

ALCO VALVE CO.

861 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

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. . . and the new Baltimore Airport

Architects and Engineers:
Whitman, Requardt, Greiner & Associates, Baltimore, Md.

Heating, Plumbing and Air Conditioning Contractor,
Lloyd E. Mitchell, Inc.
Baltimore, Md.

is ALL-SARCO

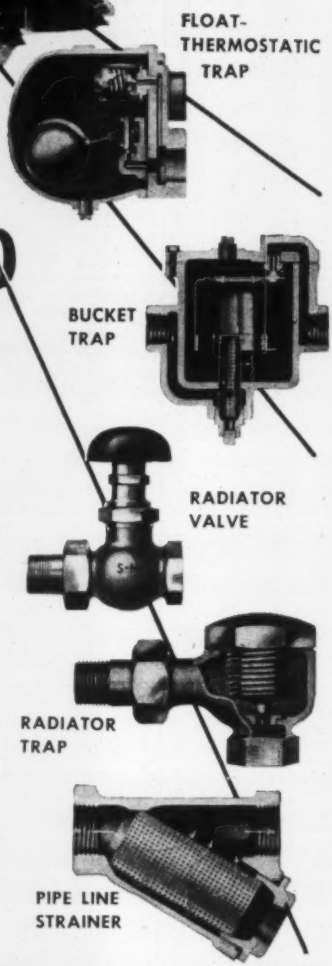
Friendship International Airport with a landing runway of 9,450 feet is the largest civilian runway on the eastern seaboard. The Administration Building alone occupies more than an acre of ground and is a combination office building, terminal and hotel, with roomettes, showers and dressing rooms for hold-over passengers.

Years of planning preceded its construction. And after mature consideration the heating engineers selected more than 1000 Sarco accessories to keep the operation reliable, satisfactory and efficient from a fuel consuming standpoint.

They decided to standardize on SARCO. Not on one type of trap —but three different types, each used in its proper place. Sarco radiator traps and valves, of course. Then various forms of the Sarco float-thermostatic trap for drips, risers and unit heaters, and Sarco bucket traps for the water heaters.

Then to insure continuous operation, Sarco pipe line strainers were placed at all important points.

FOR YOUR PLANT: You may need an entirely different selection from the many types and sizes of Sarco steam traps and temperature control. Certain it is that the Sarco Representative near you can understand your needs and suggest the combination which will give you utmost heating satisfaction for years to come at lowest heating costs.



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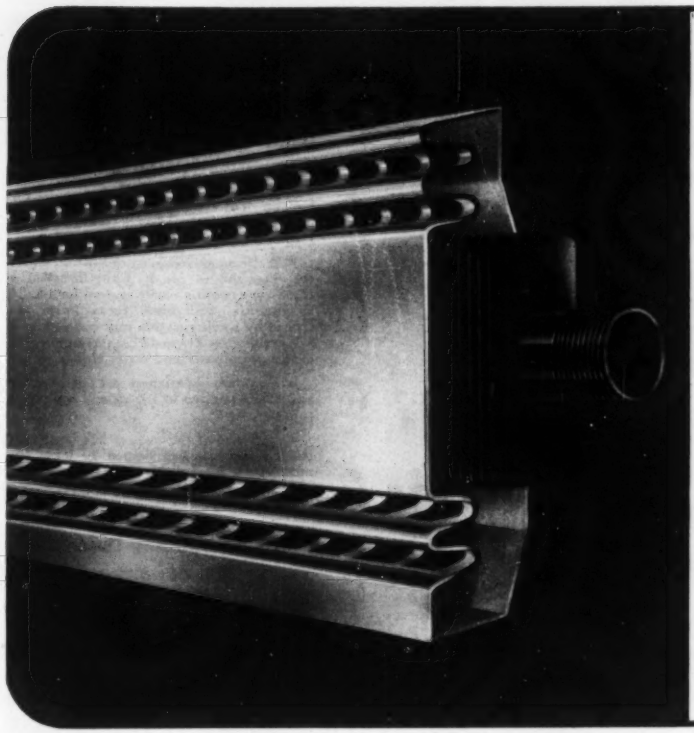
SARCO SAVES STEAM

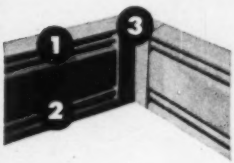
SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

dunham baseboard heating



other performance-proved points you'll want to know about



1. Unique Design of front section guides heated air away from walls, minimizes smudging.

2. Flush-with-Floor bumper permits wall-to-wall carpeting, presents finished appearance, speeds room cleaning.

3. No Pipe Fittings visible. Door and Finishing Caps conceal all piping, assure neater looking installation.

engineered up to performance not down to price!

Sure, price is important—but not more so than *performance*. After all, your customers live with—and judge you by—the *performance* record of the products you sell and install.

And there's where Dunham Baseboard Radiation plays right into your hands.

Your customers will like the fact that Dunham's method of mechanically attaching fins to pipe eliminates solder bond, provides greater heating surface, speeds heat transfer. And they'll find Dunham's individual room heat control damper both a convenience and an economy.

You'll like the fact that Dunham Baseboard is easy to install in any type of building . . . *old as well as new*. For example, in existing masonry construction, Dunham Baseboard can be installed without recessing into plaster.

Send For Free Booklet No. 439-D2

Contains complete information . . . including capacity tables, installation instructions for various types of applications, design details and typical specification sheets. Write for your free copy.

DUNHAM

C. A. DUNHAM COMPANY
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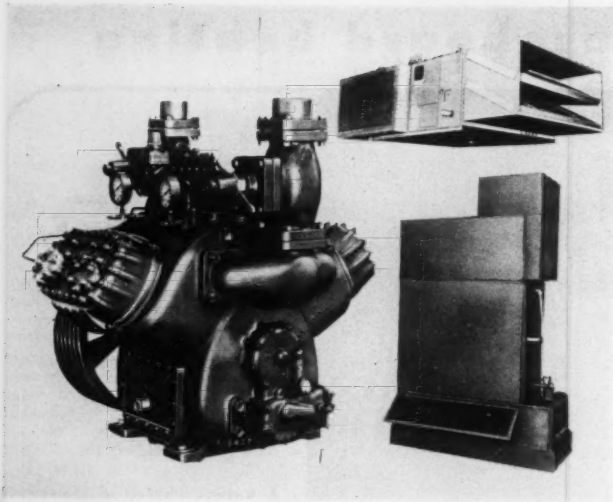
heating systems and equipment

Vari-Vac Differential Heating • Fin-Vector Radiation • Convector Radiation
Vacuum Pumps Condensation Pumps • Horizontal Heaters • Vertical Heaters • Cabinet Heaters Traps Valves



Who Makes a COMPLETE Freon Reciprocating System?

A completely integrated and balanced system—all *manufactured*, not just assembled, by the *one* manufacturer—that's Worthington.

No other company makes a wider variety of complete Freon reciprocating systems.

No other company offers more perfectly balanced operation of inter-related components—for lowest costs, longest life.

Worthington Freon-12 Compressors and Refrigeration Units. One basic compressor design covers a size range from 2 to 125 tons, with three cylinder sizes. Simplified construction. Lightweight automotive pistons. Worthington Feather* Valves—simplest, lightest, quietest ever made. Internal manifold. Renewable cylinder liners and leakproof, continually-cleanable force-feed lubrication in larger sizes. Positive manual or automatic capacity control. Available in self-contained compressor-condenser units.

Worthington Air-Handling Units. Perform complete air conditioning functions. Water cooling or direct expansion. Five sizes: 4 to 60 tons, 4000 to 13,500 cfm. Horizontal or vertical. Sectional design.

Worthington Evaporative Condensers. All parts exposed to moisture made of zinc-coated steel, bonderized and coated with rubber-base enamel containing special rust inhibitor. Prime surface—no fins to clog. Staggered coils permit air deflection and complete wetting. Six sizes from 2000 to 27,000 cfm.

Also: *Worthington Evaporative Coolers* in same range.

*Reg. U. S. Pat. Off.

Bulletins containing complete information are available

First Completely Air-Conditioned Apartment House in New England

Beacon Towers Apartments, Brookline, Mass. is the first building of its type in New England to be 100% air-conditioned.

E. A. Berman Company of Boston, under the direction of M. L. Cail, installed a three-zone cooling water system for the 34 apartments. Individual room units are served by a refrigeration unit consisting of a Worthington Freon-12 compressor, evaporative condenser and water chiller.

The system is designed and operated for automatic heating in winter and cooling in summer.

Experience of the owners has been that the air conditioning helped to lease the apartments for 3-year periods.

Laboratory Air Conditioning Duplicates Mill Conditions

Worthington also manufactures a complete line of *centrifugal* refrigeration.

When the W. Harrison Hightower Textile Engineering Building was built at the Georgia Institute of Technology, Atlanta, to house its textile school, Worthington refrigeration for air conditioning was installed to provide the proper temperature and relative humidity required for textile processing.

Fourteen separate rooms are individually air-conditioned, through a chilled water system, from a 150-ton Worthington centrifugal refrigeration system, electrically-driven. This machine is equipped to shut off automatically in the event of trouble anywhere in the system.

Installed by Engineering Contractors, Atlanta, Ga.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

INVESTIGATE

MORE WORTH WITH WORTHINGTON

Consult Classified Telephone Directory for nearest Worthington distributor. Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J., specialists in air conditioning and refrigeration for more than 50 years. A.1.1

demand DETROIT CERTIFIED CONTROLS

DETROIT NO. V-541 MAGNETIC GAS VALVE

Large gas capacity and low pressure drop • Tight seating eliminates leakage—no flashbacks • Absolutely quiet operation • Plunger seal prevents sticking • Spring action plunger provides smooth opening and long plunger life • Kick-off spring eliminates plunger "hang-up" • Easily installed and serviced.

Voltages: 24 volts, 60 cycles; 115 volts, 60 cycles. Sizes: ⅜" through 1". Can be used with either natural gas, L. P. or L. P. air mixtures.

Introducing

THE NEWEST ADDITION TO A QUALITY LINE!

Here's brand new evidence of what most heating men have known for years—it pays to demand DETROIT! Why? Because DETROIT Certified Controls are designed and built with one purpose in mind . . . to make any heating unit better! And one sure way to make gas heating units better is to install DETROIT'S new V-541 Magnetic Gas Valve. Having many new and outstanding features, the V-541 is a truly significant advance in solenoid valve design and is engineered for use on a wide variety of gas fired units. So insist that your source of supply furnish DETROIT Certified Controls with all your heating equipment. We guarantee you'll be doing yourself *and* your customers a lasting favor! For further facts, write for Bulletin No. 234.

No. 411 Thermostat—A sensitive and accurate *Timed Cycling* thermostat for all types of heating systems. Provides close control of room temperature. Attractively styled, easily installed and adjusted. Write for Bulletin No. 193 and Form No. 1545.

DETROIT
LUBRICATOR COMPANY

5900 TRUMBULL AVE., DETROIT 8, MICHIGAN
Division of American Radiator & Standard Sanitary Corporation
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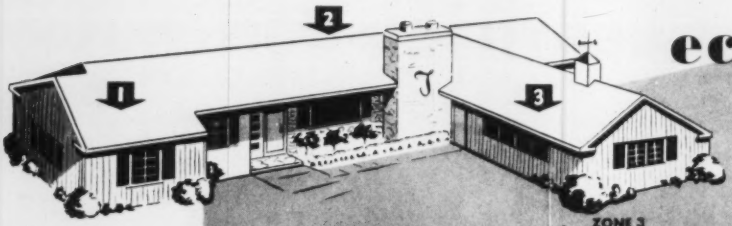
"DETROIT"

DETROIT HEATING AND REFRIGERATION CONTROLS • ENGINE SAFETY CONTROLS • FLOAT VALVES AND OIL BURNER EQUIPMENT • DETROIT EXPANSION VALVES AND REFRIGERATION ACCESSORIES • STATIONARY AND LOCOMOTIVE LUBRICATORS

Serving home and industry AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

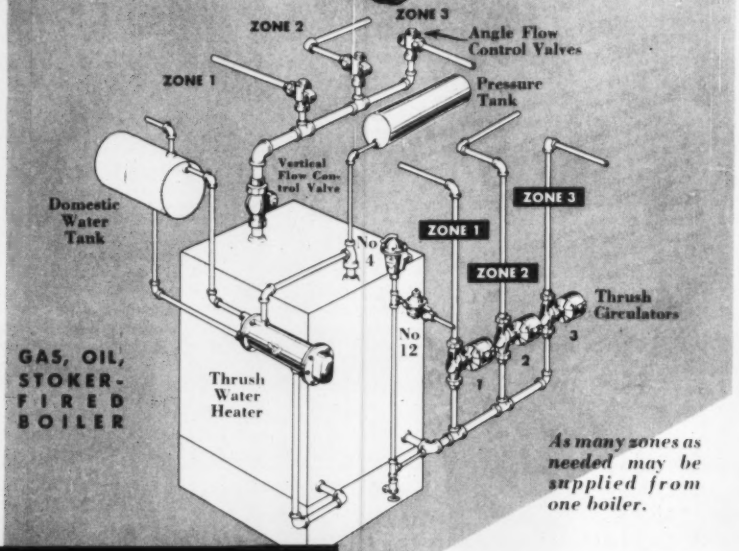
ZONED FOR COMFORT and economy!



ZONE 1—*Kitchen, Utility Room, and Servants' Quarters.*

ZONE 2—*Living Room, Den, Dining Room, and Game Room.*

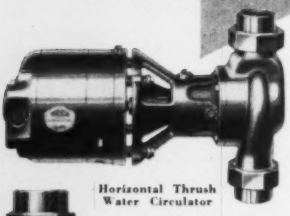
ZONE 3—*Bedroom Wing.*



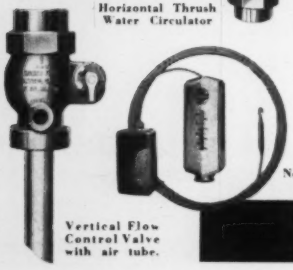
As many zones as needed may be supplied from one boiler.

THRUSH forced circulating

FLOW CONTROL HOT WATER HEAT



Horizontal Thrush Water Circulator

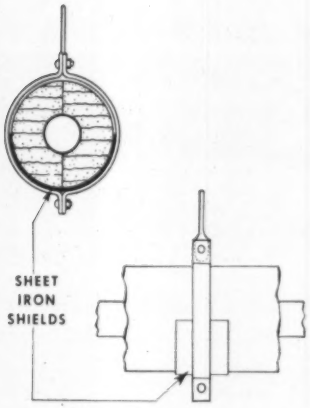


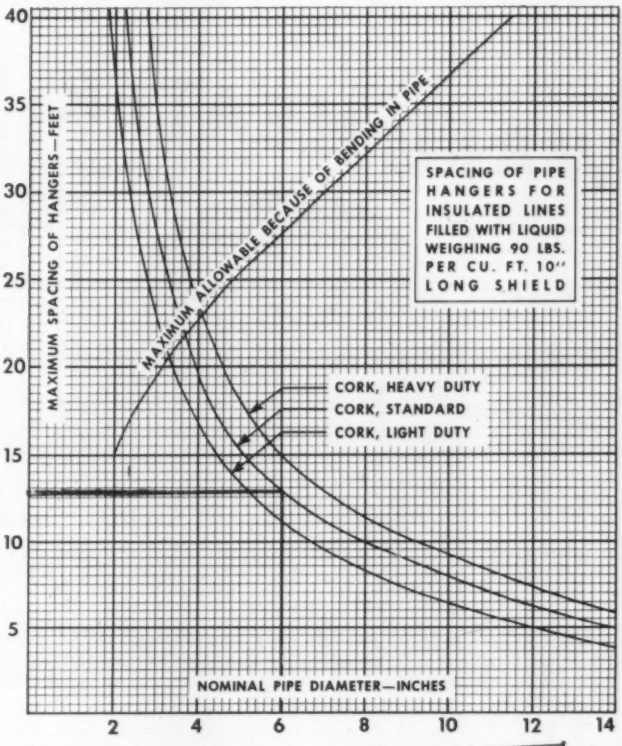
No. 201 Radiant Heat Control

Vertical Flow Control Valve with air tube.

ANY HOT WATER heating plant may be zoned easily and inexpensively with Thrush Flow Control System, to supply as many zones as are needed from a single boiler. These zones may be in the same house or in adjacent buildings, often greatly reducing equipment cost because the one boiler replaces many. Only a Circulator, with Relay Transformer, Flow Control Valve, and a Radiant Heat Control are added for each additional zone . . . simple units which give dependable and individual comfort control in each zone. Thrush Water Heater eliminates the need for separate domestic water supply as the same heating boiler automatically provides plenty of hot water for kitchen, laundry and bath summer or winter. Ask your wholesaler today for more information or write Dept. E-2 for bulletin on Zoned Heat.

H. A. THRUSH and CO.
PERU . . . . . INDIANA





WE HAVE BEEN ASKED:

What is the proper spacing of hangers to support cork insulated lines?

Recently we received a letter which posed the following problem:
"We are redesigning some process piping, and we want to make sure that we correctly space the hangers on our cold lines to avoid compression of the cork covering."

To answer his question we sent this manufacturer the graph shown above. It is a dependable guide to the efficient spacing of hangers. Here's an example of how it works:

Let's assume that lines are filled with liquid weighing 90 lbs. per cubic foot. Shields are 10" long—made of 16-gauge sheet iron—and enclose half the circumference of the covering. Now let's assume that we are going to insulate a 6" pipe with standard thick cork covering. First, draw a red line, as we've done on the graph above, from the 6" indication at the bottom of the graph to the point where it intersects the line marked Cork, Standard. Then carry the line to the left. Read the figure at the point where it reaches the left-hand margin. That figure tells how many feet apart hangers should be spaced. Under the conditions of this problem—12½ feet.

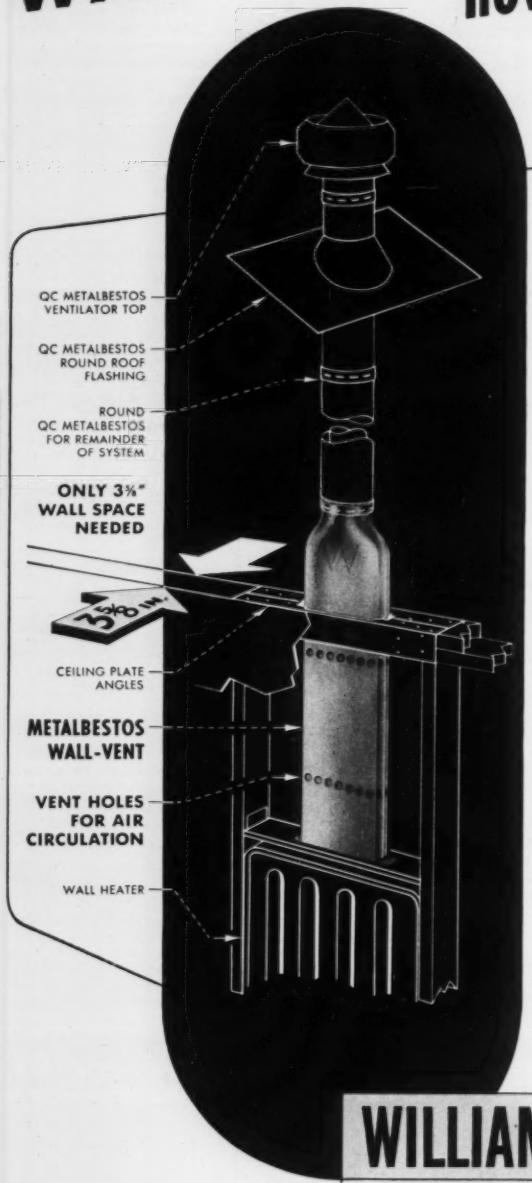
While this chart applies only to liquids weighing about 90 pounds per cubic foot and for 10" shields of 16-gauge sheet iron, similar charts can be developed for other liquids and methods of hanging cork covering. So the next time you plan a cold line installation call in your Armstrong engineer.

He'll be able to give you the best hanger specification for your particular needs. You'll find that he can help you in other ways, too, because almost every insulation job presents some problems that his knowledge and experience can help solve.

IF YOU HAVE ANY QUESTIONS on low- or high-temperature insulations, feel free to call the engineer in your nearest Armstrong district office or write to the Armstrong Cork Company, 4402 Concord Street, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

WALL HEATER VENTING now SAFE even with combustible walls!


QC METALBESTOS VENTILATOR TOP
QC METALBESTOS ROUND ROOF FLASHING
ROUND QC METALBESTOS FOR REMAINDER OF SYSTEM
ONLY 3⅛" WALL SPACE NEEDED
3⅛ 1/2 IN.
CEILING PLATE ANGLES
METALBESTOS WALL-VENT
VENT HOLES FOR AIR CIRCULATION
WALL HEATER

NEW QC METALBESTOS WALL-VENT permits use within ⅜ inch from combustible material.

COOL WALLS AND PROPER VENTING of wall heaters—positive safety even in pine board walls with unfurred 2" x 4" studding—are provided by the new QC METALBESTOS WALL-VENT.

UNDERWRITERS' LABORATORIES, INC. list QC *METALBESTOS WALL-VENT* as a Type B gas vent—and add an additional provision permitting it to be installed with **⅜ inch** clearance from combustible material. No other gas vent pipe has a similar listing.

QC METALBESTOS WALL-VENT saves the expense of thicker studding, furring or metal sheathing previously necessary. Extensive tests have proved that this new unit keeps adjacent wall surfaces even cooler than the former Metalbestos wall heater vent pipe.

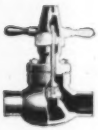
Write today to Department **N** *for complete information on QC METALBESTOS WALL-VENT and QC METALBESTOS round pipe and fittings.*

WILLIAM WALLACE CO.

BELMONT · CALIFORNIA

HENRY *really gives you something extra*

a few of many outstanding advantages



IN PACKLESS VALVES, still the only Balanced-Action valve on the market—no extra cost

IN STRAINERS, forged brass end caps with integral fittings, reinforced screen, large filtering area, distortion-proof clean-out flange

IN DRIERS, forged brass end caps with integral fittings, natural finish, Abso-Dry pressure sealed, dispersion tube and extra capacity

IN WING CAP VALVES, greater flow, bolted bonnet and self-aligning stem disc

IN RELIEF VALVES, diaphragm construction, positive controlled cushion reseating with relief capacity that meets latest code requirements

IN AMMONIA VALVES, compact and strong, self-aligning stem disc

IN ALL HENRY PRODUCTS—ADVANCED FIELD-PROVEN DESIGN AND CONSTRUCTION

Sold by Leading Wholesalers

HENRY VALVE CO.

HENRY VALVE CO. CONTROLLING FLOW

Valves • Driers • Strainers • Control Devices and Accessories for Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILL. (CHICAGO SUBURB)
CABLE: HEVALCO, MELROSE PARK, ILLINOIS

Seamless brass tube—

having end spun—

constitutes the

percussion primer tube blank

Percussion primer tube-body blanks can be produced in a jiffy here at Wolverine by the well-known Spun End Process*, which is used to form the end.

These fabricated blanks can be furnished by us to prime contractors who then just need to drill or punch the holes along the length of the tube, face to length and ream and tap.

We are equipped to fabricate these blanks of other metal besides brass.

We invite prime contractors to give consideration to the many advantages presented by this fast, efficient, accurate process used for forming products of this type out of Wolverine seamless tube.

Our Customer Engineering Service will be glad to give you any assistance you may require in setting up the production of essential parts requiring ends that must be entirely or partially closed.

*a patented process RE: 22465

WOLVERINE TUBE DIVISION

Calumet & Hecla Consolidated Copper Company

INCORPORATED

Manufacturers of seamless non-ferrous tubing

1419 CENTRAL AVENUE • DETROIT 9, MICHIGAN

Plants in Detroit, Mich., and Decatur, Ala.

Wolverine Mill Depots:

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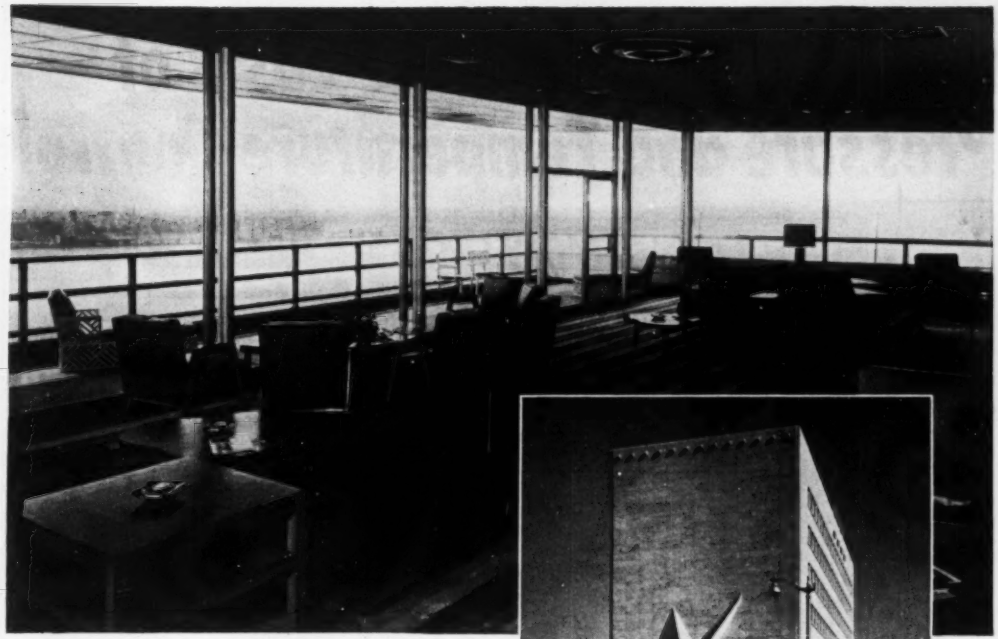

Lounge and exterior, Veterans Memorial Building, Detroit, Mich.
Architects and Engineers: Harley, Ellington & Day, Inc., Detroit, Mich.
General Contractors: Kuhne-Simmons Co., Inc., Detroit
Air Conditioning Contractors: American Refrigerating Co., Detroit

Simply beautiful

kno-draft
adjustable air diffusers

In their beautiful simplicity of line, Kno-Draft Adjustable Air Diffusers are grace notes for any decorative theme. But unless you just happened to look ceilingward, you might not ever notice them in the modern lounge above. Nor would they be more obtrusive in period surroundings.

Certainly, Kno-Draft Adjustable Air Diffusers will never call attention to themselves by discomforting the occupants of any room. All that their name implies, Kno-Draft Adjustable Air Diffusers circulate air gently and *without draft* . . . keep temperature uniform throughout the conditioned area. Air volume and flow pattern are adjustable *after* installation . . . thus simplifying the engineering of the job as well as providing flexible control to meet both present and future conditions.

You'll find Kno-Draft Adjustable Air Diffusers in many of America's notable and architecturally significant buildings. Whatever the air conditioning requirements, there are types and sizes to meet them. Write us for detailed information.

KNO-DRAFT DATA BOOK: Complete specifications, engineering and installation data on Kno-Draft *Adjustable* Air Diffusers. To get your copy, simply fill in and mail the coupon. No obligation, of course.

TRADE MARK "KNO-DRAFT" REG. U. S. PAT. OFF.

W. B. CONNOR ENGINEERING CORP.
Danbury, Connecticut
Air Diffusion • Air Purification • Air Recovery
In Canada: Douglas Engineering Co., Ltd.,
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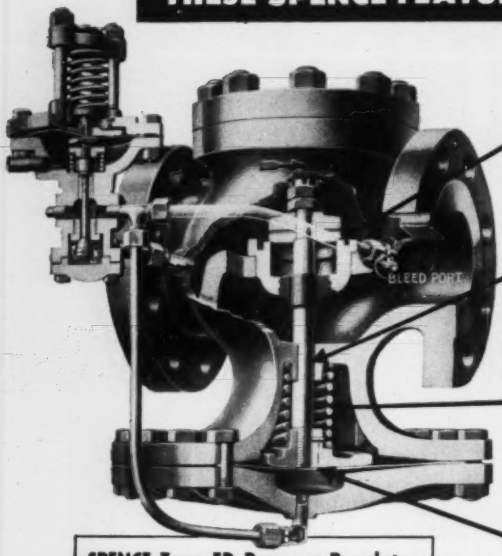
W. B. CONNOR ENGINEERING CORP.
Dept. G-21, Danbury, Connecticut
Please send me, without obligation, my copy of the Kno-Draft Air Diffuser Data Book.

Name .....
Position .....
Company .....
Street .....
City ..... Zone ..... State .....

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

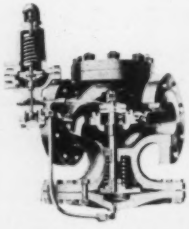
SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

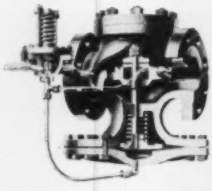
YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.

Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

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The Springs Cotton Mills
Ford Motor Company
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National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

Remember—only genuine **TUBE-TURN Welding Fittings are identified by these trade marks!**

tt and TUBE-TURN are trade marks of Tube Turns, Inc.

Unique forging process gives strength

TUBE-TURN WELDING FITTINGS have a close-grained metal structure fully as strong as the pipe to which they are welded. Welding elbows, for example, are forged by the only process that achieves wall thickness as uniform as the original seamless pipe . . . guaranteeing *full strength throughout*. And, their true circularity means accurate alignment, regardless of angle, for strong, tight, permanently leakproof connections.

Forged-in strength is inherent with all types of TUBE-TURN Welding Fittings. It's one of the big reasons why it pays to specify them for *all* jobs. Get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

Write Dept. A-2 for free booklet giving Dimensional Data on types, sizes and materials of TUBE-TURN Welding Fittings and Flanges.

"Be sure you see the double tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO . . . A wholly owned subsidiary of TUBE TURNS, INC.

Wrought iron downspout welded on Cleveland Bridge

Cleveland's Abbey Avenue Bridge is big enough to collect a lot of water in a rainstorm. To get rid of it, nine downspouts, ranging from 39 to 66 feet in height, carry the water to underground sewers. Wrought iron pipe was chosen for its resistance to rust. All-welded piping was chosen for long life, structural rigidity. Weak joints here could be fatal!

Contractor on this job, the Gorman-Lavelle Company of Cleveland, likes speed on the job. The piping itself was quickly fabricated on the ground, then raised into position. Piping went up fast—and safely!

A lateral connection near the top of the spout leads up to drains on the bridge. TUBE-TURN Welding Reducers are installed at the very top of the spout. The drain sets in the reducer with a loose fit, allowing 2" clearance all around. Thus the bridge can expand on its roller bed without disturbing the pipe. TUBE-TURN Welding Reducers, Elbows, Laterals and Caps are all part of the leading line in welding fittings.

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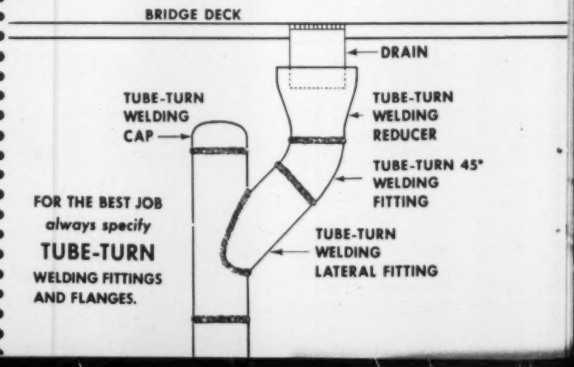
LOUISVILLE, KENTUCKY

Note TUBE-TURN Welding Elbow at bottom of downspout. Drain pipe will be connected to underground sewer. Underground, too, a system welded with TUBE-TURN Welding Fittings is the best long-term bet—there are no threads to corrode, the problem of leakage is eliminated.



FOR THE BEST JOB always specify **TUBE-TURN** WELDING FITTINGS AND FLANGES.

TUBE TURNS, INC., Dept. A-2
224 East Broadway, Louisville 1, Kentucky

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Position .....
Company .....
Nature of Business .....
Address .....
City ..... *State* .....

The Importance of the Revolving Discharge Outlet in the Heating of Industrial Buildings

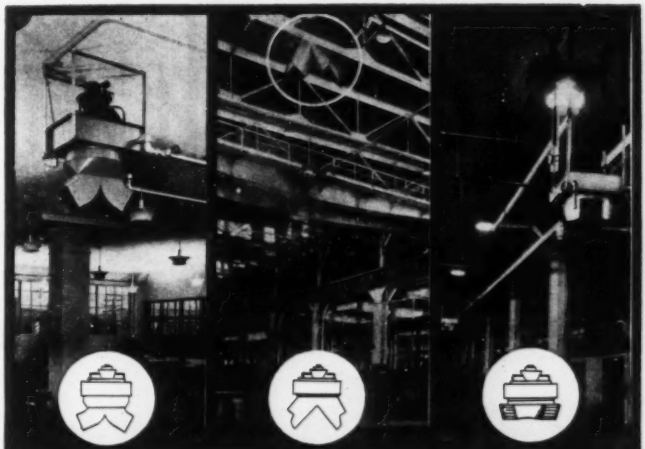
by D. Gilbert

The almost universal use of unit heaters for industrial plant heating indicates a conviction on the part of plant engineers, managers, consulting engineers and architects that this is the most satisfactory way of heating buildings and work rooms. Industry has come a long way, indeed, from the days not too long ago, when pipe coils, suspended from side walls or under windows, were the common means of heating a plant.

But, as pointed out in the article on Unit Heaters in a leading authoritative publication:

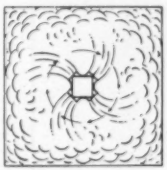
"In order to direct the air to points desired, and to diffuse the air to avoid drafts, unit heaters are commonly equipped with directional outlets, adjustable louvers, or fixed types of diffusers. . . . As hot blasts of air in the working zone are usually objectionable, heaters mounted on the floor should have their discharge outlets above the head line, and suspended heaters should be placed in such manner and turned in such direction that the heated air stream will not be objectionable in the working zone."

This is sound advice, but even with such stratagems, it is seldom possible to obtain satisfactory results. The basic difficulty lies in the use of *stationary* discharge outlets. Only one type of unit heater is able to avoid the objectionable "hot blasts" so distressing to workers in fixed positions, as on assembly lines or at machine tools. That is the heater suspended from roof or ceiling in which the downward discharge of heated air is distributed by slowly *revolving* discharge outlets. There are no fixed blasts, no chilly corners untouched by the air streams; just a gentle, thorough movement of the heated air at the working level, over obstacles, around obstructions, moving under tables, benches, truck bodies, airplane wings, even into repair pits. The result is an evenly warmed blanket of air at the working level, a gently moving, invigorating atmosphere that is pleasantly stimulating to the worker and better for his health.



The Discharge Outlets REVOLVE —only with WING unit heaters

Side view showing moving streams of heated air



Top view showing coverage

The distinguishing feature of the WING Revolving Unit Heater, which makes its performance so outstandingly superior to other heaters is the Revolving Discharge Outlet. These outlets, moving slowly through a complete circle flood the entire heating area with a blanket of fresh, live warm air. The gentle air motion caused by the constantly changing directions of the heated air from the revolving outlets creates a refreshing stimulating atmosphere beneficial to employee morale and productivity. Hot blasts and chilly areas are eliminated. Get complete information by writing today for Bulletin HR-5.

L. J. Wing Mfg. Co.

Executive Offices and Factory: 140 *Vreeland Mills Road, Linden, N. J.*

Canadian Factory:
Montreal, Canada

In Europe:
ETABLISSEMENTS WANSON
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WING

Wing

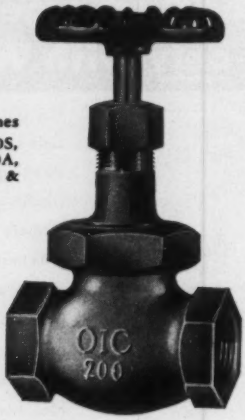
Revolving UNIT HEATERS

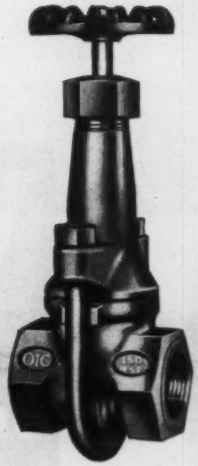
OIC FOR

GATES, GLOBES, ANGLES, CHECKS
There's this long line to choose from...

BRONZE

¼-inch to 3-inches
125S, 150S, 200S, 300S, 350S, 300A, 200, 400, 2000 & 2500WOG.



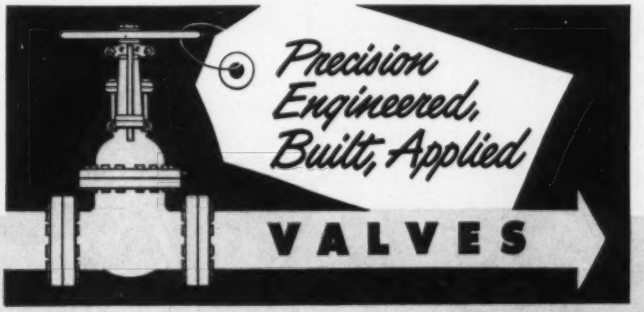


IRON

1¼-inch to 16-inches
125S, 150S, 250S, 175, 200, 400 & 300 WOG.
CLIP GATES—¼-inch to 4-inches.

OIC
FOUNDED 1883

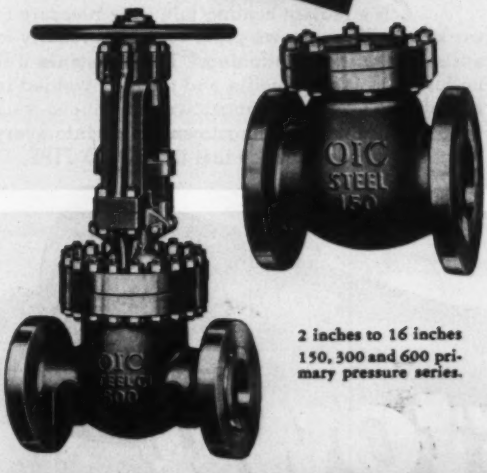
ANY VALVING REQUIREMENT



FORGED STEEL

¼-inch to 2-inches
600 primary pressure series.

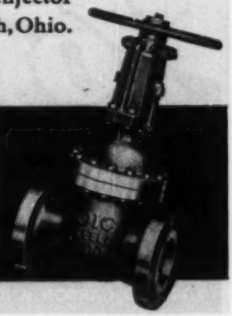
CAST STEEL



2 inches to 16 inches
150, 300 and 600 primary pressure series.

Screwed, flanged, butt weld and socket weld ends . . . rising and non-rising stems . . . outside screw and yoke . . . alloy metal seats, discs and wedges, composition discs . . . union, inside screw and bolted bonnet . . . tapered and parallel seat wedges.

If you're needing valve application know-how, call the nearby OIC distributor or write direct to us. The Ohio Injector Company, Wadsworth, Ohio.



VALVES

FORGED AND CAST STEEL • IRON • BRONZE

Good workmen + good tools + GOOD PIPE = GOOD JOB!

7 POINTS OF UNIFORM GOODNESS IN YOUNGSTOWN STEEL PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
- uniform roundness and straightness

ON a radiant heating job, it's a pleasure to work with Youngstown pipe. It bends readily to a true arc without flattening. That's because it is uniformly soft and ductile, and soundly welded in manufacture by the Youngstown continuous-weld process. The name Youngstown, rolled into every length, is your assurance that it's GOOD PIPE.

QUALITY YOUNGSTOWN SERVICE

Youngstown STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY — General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel — Export Office - 500 Fifth Avenue, New York

PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - HOT AND COLD FINISHED CARBON AND ALLOY BARS - RODS - SHEETS - PLATES - CONDUIT - RAILROAD TRACK SPIKES.

Aerofuse

PECK & PECK

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WSB-TV CONTROL ROOM

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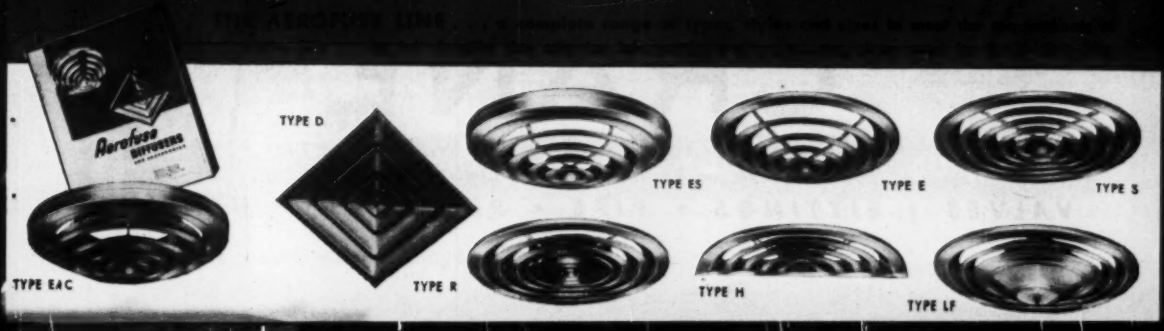


Longer service life at lower final cost

with dependable CRANE VALVES

No. 1610 Diaphragm Valve. Ask for literature on full line through your Crane Branch or Crane Wholesaler.

CASE HISTORY FROM CRANE FILES

PROBLEM: To find a more efficient and economical replacement for plug cocks having an average life of only 2 to 8 weeks in pipe lines handling liquid clay to filter presses.

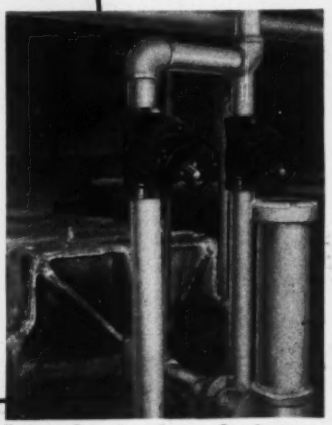
WORKING CONDITIONS: Working pressure 140 psi, with liquid clay flow creating highly erosive effect; also corrosive. Strong tendency to clogging. Operating cycles 5 to 6 per day; relatively quick opening and closing required.

SOLUTION: Crane No. 1610 Diaphragm Valves, iron body, packless design, with separate disc and diaphragm.

RESULT: After 11 months' uninterrupted service, Crane valves showed no significant wear or damage resulting from normal operating conditions. User assured of greatly reduced maintenance and replacement costs over plug cocks. No. 1610 Diaphragm valves approved for standardization on all filter press piping.

Another example of the greater value in Crane Quality, and the lower final cost of Crane Valves for every service. That's why . . .

More CRANE VALVES are used than any other make!



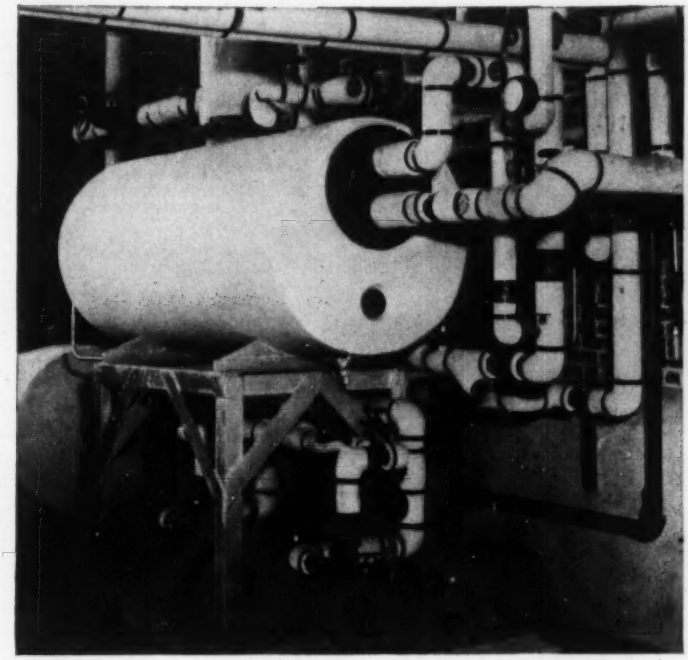
The installation—Onondaga Pottery Co., Syracuse

CRANE

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.

Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



SCHAUB
BOILER RETURN SYSTEMS

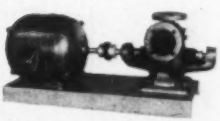
Model S6F Schaub Duplex Deaerator System at the Lawrence Hose Co. (formerly Anchor Thread Co.), Lawrenceville, N. J. Of the 200 H. P. total load, 50% is live steam usage, with 15% returns from a hot water storage heater and 35% returns from high pressure unit heaters.

Judge on Facts...Prove to Yourself —

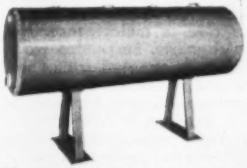
SCHAUB'S YOUR BUY!

Look at Schaub's three outstanding *exclusive features.* Check them point for point with your own experience. Then you'll realize how much more these *plus values* really mean...and why a Schaub System can actually give you more — in low-cost maintenance, improved operating economy . . . and enduring dependability for many years to come. In short, you can't afford to buy a boiler return system until you know the Schaub story ...then, you won't be satisfied with less.

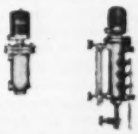
Only* SCHAUB *Has This Exclusive Combination of Features . . .



No more periodic pump maintenance! Schaub Master-Bilt Pumps have new Fleximatic Mechanical seals and permanently lubricated ball bearings. No more water puddles. No more scored shafts. No pump packing or greasing to do — ever!



10-year receiver corrosion guarantee. Schaub engineers worked with leading chemical researchers to develop the Chromosoid lining. You're safe from costly premature replacements. No more rust-clogged systems.

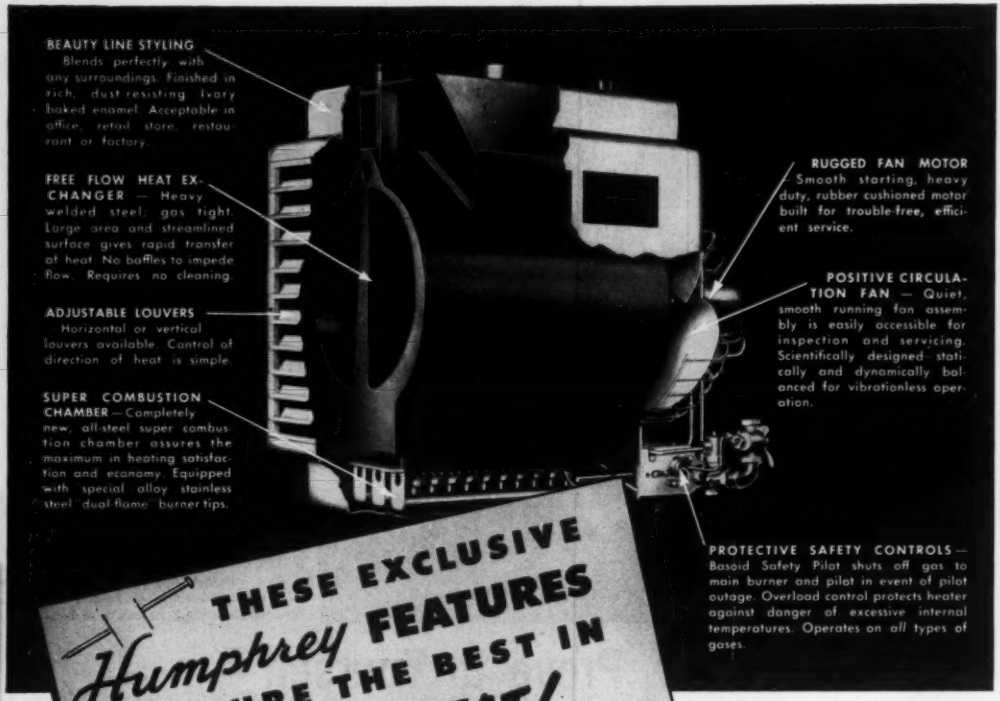


Schaub Systems use only proven super-SAFE Magnetrol pump control and low-water cut off. No bellows to stiffen, no packing to bind, no tricky electrode circuits to fail. Magnetrol's tireless, friction-free magnetic force provides ultra-dependable switching action at all times. BOILER SAFETY KNOWS NO PRICE.

Schaub also builds Patented Heat-Reclaim and Spray-Type Deaerating Systems for exacting requirements from 10 to 1000 Boiler Horse Power. Write for new Schaub Catalog No. 55 which gives more information on all types of Schaub Systems.

FRED H. SCHAUB ENGINEERING COMPANY

2116 S. Marshall Boulevard • Chicago 23, Illinois


BEAUTY LINE STYLING
Blends perfectly with any surroundings. Finished in rich, dust-resisting Ivory baked enamel. Acceptable in office, retail store, restaurant or factory.
FREE FLOW HEAT EXCHANGER — Heavy welded steel; gas tight. Large area and streamlined surface gives rapid transfer of heat. No baffles to impede flow. Requires no cleaning.
ADJUSTABLE LOUVERS
Horizontal or vertical louvers available. Control of direction of heat is simple.
SUPER COMBUSTION CHAMBER — Completely new, all-steel super combustion chamber assures the maximum in heating satisfaction and economy. Equipped with special alloy stainless steel dual-flame burner tips.
RUGGED FAN MOTOR — Smooth starting, heavy duty, rubber cushioned motor built for trouble-free, efficient service.
POSITIVE CIRCULATION FAN — Quiet, smooth running fan assembly is easily accessible for inspection and servicing. Scientifically designed statically and dynamically balanced for vibrationless operation.
PROTECTIVE SAFETY CONTROLS — Basoid Safety Pilot shuts off gas to main burner and pilot in event of pilot outage. Overload control protects heater against danger of excessive internal temperatures. Operates on all types of gases.

THESE EXCLUSIVE Humphrey FEATURES ASSURE THE BEST IN GAS HEAT!

Increase your profits and gain assurance of customer satisfaction with Humphrey Unit Heaters.

Sell complete heating comfort . . . trouble free service . . . economical performance. Your profits grow when you sell Humphrey Unit Heaters.

Clean, economical heat is furnished instantly and to any point needed. These compact, self-contained heaters are equipped with a powerful fan to circulate heat in remote areas. Cold corners are eliminated.

The economical Humphrey Unit Heaters are saving money for users everywhere. Completely automatic, needs little care or maintenance. No fuel storage, handling or waste. Suspended from ceiling, the heater is entirely removed from floor space leaving entire floor for productive facilities.

Humphrey Unit Heaters are a complete heating plant in themselves. A gas supply line, electric current for fan motor and provision for venting is all that is needed. Eliminates steam and water lines, boilers and fireman.

Ideal for heating stores, restaurants, factories, auditoriums, warehouses and countless other buildings.

Sell economical heating . . . complete comfort . . . controlled heat circulation. Humphrey Gas Unit Heaters give you these advantages. Write today for additional information.

Radiantfires

Circulators

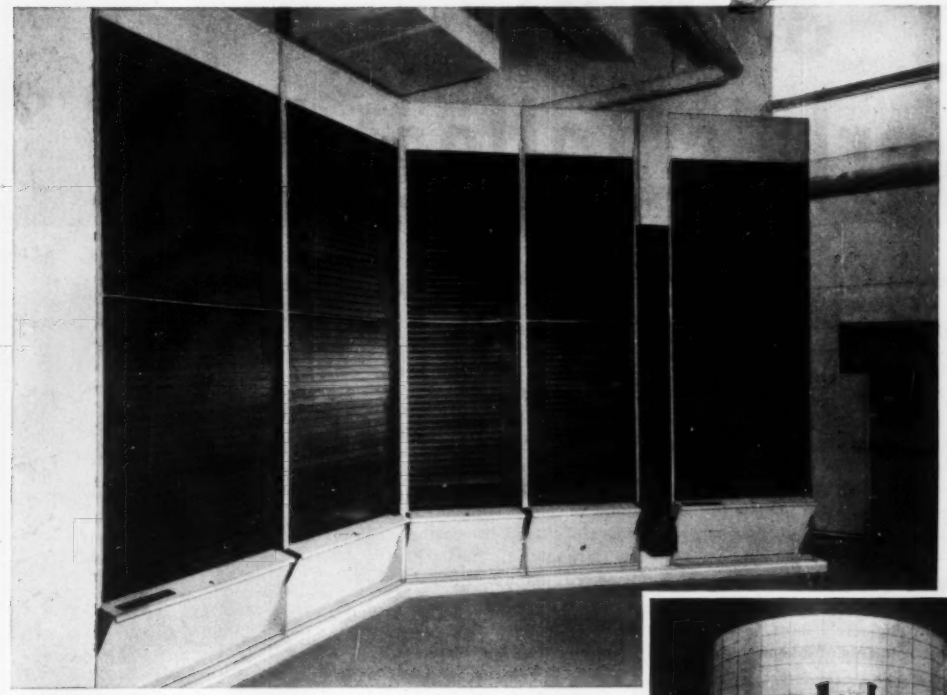
GENERAL GAS LIGHT COMPANY

KALAMAZOO, MICHIGAN

Wall Heaters

Unit Heaters

today's best buy is better air!



Berkley (Calif.) High School Auditorium
Architect: Henry H. Gutterson, San Francisco
Consulting Mechanical Engineer: G. M. Simonson, San Francisco
Contractor: Marelich Mfg. Co. Inc., San Bruno

AAF MULTI-DUTY

most widely used automatic air filter in the world

Here Multi-Duty goes to school, though it's just as popular for rugged service in steel mills or defense plants.

When Berkley, California built its $3,000,000 high school auditorium it did things in a big way. This marvel of construction seats 3500 people and its ventilation system supplies 156,000 C.F.M. of clean air for their comfort. Such a large air volume should have automatic filtration and that's why the AAF Multi-Duty installation shown above was selected for this project.

The Multi-Duty automatic filter, because of its self-cleaning feature, is ideal for applications of this type where ventilating systems are not in continuous use. The filter is always in efficient operating condition without depending on the human element.

The exclusive principle of overlapping panel construction in the Multi-Duty was introduced by AAF in 1927. It is still the most practical method of combining the function of self-cleaning with the operating cycle. Although there have been numerous improvements in the design of individual panels and in unit construction, this basic principle has never been surpassed.

For detailed and illustrated description of Multi-Duty write today for Engineering Bulletin No. 241-B.

AAF **American Air Filter**
COMPANY, INC.

373 Central Ave., Louisville 8, Kentucky • In Canada: Darling Brothers, Ltd., Montreal, P. Q.

Solved!
World's Tallest Trick
. . . in air conditioning

Every architect and engineer knows air conditioning jobs get tougher in multiple proportion to height. That's why New York's Empire State faced one of the trickiest air conditioning problems ever. It's the tallest building in the world.

Cooling off this giant involves engineering problems for which there are few precedents. Columns of refrigerated water nearly a quarter mile high—bearing down with hydrostatic pressures of more than 600 pounds per square inch—mean new kinds of equipment, new installation techniques. A plant capable of keeping these highest-in-history columns chilled and circulating —of re-processing without waste an ultimate of 5,000,000 gallons of water daily—must be designed and manufactured.

You should, of course, know the answer. It's the architect's and engineer's most frequent answer to air conditioning and refrigerating problems that can't be easily solved by precedent—

York equipment, York's seventy-five years of experience, York's seventy-five years of leadership in engineering and manufacture, have been chosen to help Empire State solve the world's tallest air conditioning job . . . and take the first step toward making selective air conditioning available to Empire State tenants where and when wanted.

WHEN YOU'RE FACED WITH ANY PROBLEM in air conditioning or refrigeration, remember York has the most complete nationwide organization of trained engineers to help you solve the initial headaches. And remember York's Certified Maintenance Plan saves your client the headaches afterwards.

YORK'S SALES POLICY IS TO WORK THROUGH YOU—to channel all contracts through the architect, engineer, contractor. Experience has shown that our knowledge, working with yours, brings best results. Check your York District Office to save time and detail on your next "tall" job. York Corporation, York, Penna.

Consulting Engineer: Edward E. Ashley
General Contractor: Starrett Brothers & Eken, Inc.
Mechanical Contractor: Almirall & Co., Inc.

The big advances come from

YORK

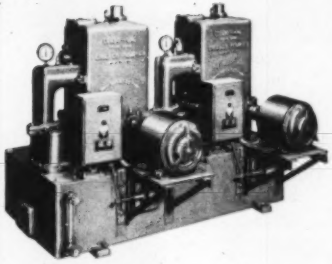
York refrigeration air conditioning

Headquarters for— **Refrigeration and Air Conditioning**

There Is A

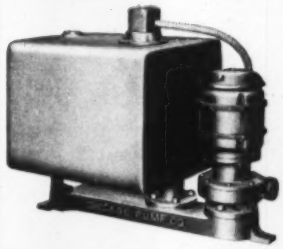
CHICAGO PUMP

For Every Heating Service In All Types of Buildings



"CONDO-VAC" VACUUM AND BOILER FEED PUMP

Picture Shows Duplex "Condo-Vac" with Duplex Automatic Control. Single units also furnished. "Condo-Vac" Vacuum Pumps are used as return line condensation, vacuum and boiler feed pumps, for vacuum heating systems. Also used for industrial services where condensation and gases are to be handled. For either intermittent or continuous duty.



"SURE RETURN" CONDENSATION PUMP AND RECEIVER

Single "Sure Return" shown. Duplex units are also furnished. Designed specifically to return HOT water to the boiler. It will not steam-bind because pump suction is always under a head and suction opening is unusually large. Capacities up to 35,000 EDR and up to 50 lbs. pressure.

"AVC" CONDENSATION PUMP AND RECEIVER

Pumps for 500 to 10,000 EDR and 10 to 50 pounds pressure. "AVC" Condensation Pumps and Receivers are simple, high grade, well-engineered, sturdy units. They occupy only a small space, with low installation cost. "AVC" Pumps are conservatively rated as to capacity and motor load.

VERTICAL CONDENSATION PUMP AND RECEIVER

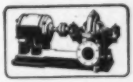
Installed in the ground to take the condensation from return lines that come back below the floor and pump them back to the boiler. Capacities up to 40,000 sq. ft. direct radiation and up to 26 lbs. pressure.

CHICAGO PUMP COMPANY

BUILDING and INDUSTRIAL DIVISION

2300 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**

Condo-Vac, Sure Return, AVC, LVC, Fire, House & Circulating Pumps
Pneumatic & Tankless Water Systems



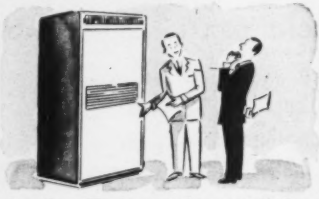
Flush-Kleen Sewage Ejectors
Little Giant & Non-Clog Bilge Pumps
Pumps for every industrial use.

"AIR CONDITIONING BUSINESS?

I was ready to give it up!" *

My end-of-the-season figures showed me I wasn't clearing a dime on our air conditioning business...

Then a Typhoon dealer I met at an air conditioning show told me about the Typhoon Profit Plan...



Are those Typhoon units rugged! Say they ought to be... Typhoon engineers have 42 years of air cooling experience behind them.

I've got to hand it to those Typhoon district sales managers – they gave my boys 100% backing...

And with the wide range of Typhoon sizes, I was able to bid on many jobs I couldn't touch before.

The first season I sold 25% more units than before—and my profits were up 40%. Brother, I'm back in the air conditioning business!

Talk to TYPHOON Now about the 5 Point Profit Plan

**A typical Typhoon case history – other success stories on request.*

TYPHOON
Air Conditioning
UNITS
1½ to 20 Tons

TYPHOON AIR CONDITIONING CO., INC.
794 Union Street, Brooklyn 15, N. Y.

A TYPICAL REPORT:

Packing like this means H & H fabricated parts reach us in perfect condition"

To make sure that every order of fabricated parts reaches you in perfect condition, H & H maintains a shipping department that is second to none. Not only is each order shipped in a rugged box, but sturdy supports are used inside to keep all parts firmly in place. In this way, no matter how complex their shape, no matter how roughly they are handled, H & H fabricated parts arrive safely, without even the slightest imperfection to destroy the quality and loyalty to specifications that you have come to expect from H & H.

Originators and sole makers of "Metalflo"— the economy tubing

H & H TUBE AND MANUFACTURING COMPANY

246 N. Forman Avenue • Detroit 17, Michigan • Vlnewood 2-3600

METALFLO • LOCKSEAM • COIL STRIP AND SEAMLESS TUBING • TUBULAR PARTS

SPECIALLY DESIGNED
for
EASIER INSTALLATION
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LONGER SERVICE

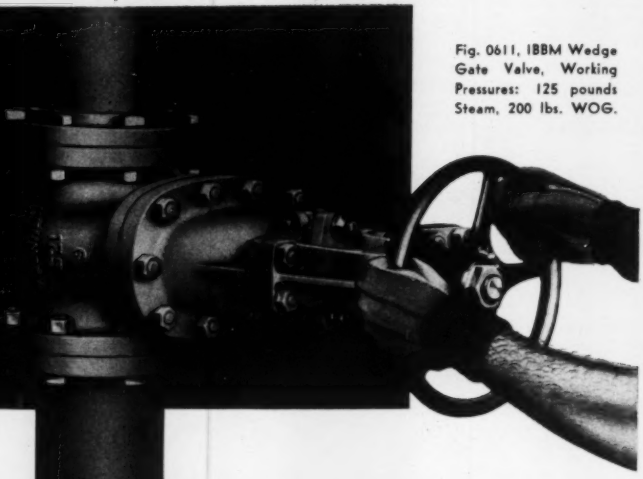

Fig. 0611, IBBM Wedge Gate Valve. Working Pressures: 125 pounds Steam, 200 lbs. WOG.

KENNEDY

JOB-FITTED

IRON-BODY WEDGE GATE VALVE

BUY FROM YOUR LOCAL DISTRIBUTOR

YOU SAVE TIME AND MONEY all along the line with Kennedy iron-body wedge gate valves because they are JOB-FITTED . . . every valve specially designed and engineered for the job it has to do.

THE WEDGE DISC is a cored casting of thick metal section, reinforced by integrally-cast interior posts and provided with openings to drain in any position.

HEAVY BRONZE DISC RINGS are forced into dovetailed grooves in the disc in a practically inseparable construction.

HIGHER STRENGTH IRON in the body and bonnet is actually 50% stronger than ordinary cast iron . . . and far exceeds A.S.T.M. requirements.

ALL CONTACT SURFACES between moving parts are bronze-to-bronze to assure easy operation.

RUSTPROOFED STEEL BOLTS AND NUTS have ample clearance to prevent distortion. Open-end wrenches may be used . . . no need for special tools. Valves can be repacked under full pressure.

EVERY FEATURE of the valve helps it do the job better—gives you a solid guarantee of economy and dependability whenever you install one of these Kennedy Job-Fitted Wedge Gate Valves.

WRITE FOR BULLETIN 107

KENNEDY JOB-FITTED VALVES

THE **KENNEDY** VALVE MFG. CO.
ELMIRA, NEW YORK

VALVES • PIPE FITTINGS • FIRE HYDRANTS

Did YOU send for your copy?
IT TELLS HOW TO BRAZE PIPE and TUBING
INSTRUCTIONS FOR BRAZING FITTINGS TO PIPE AND TUBING WITH EASY-FLO AND SIL-FOS
PREPARATION
1. CUTTING AND FITTING
2. CLEANING

■ Here in clear, concise form is the step-by-step procedure for joining ferrous and non-ferrous pipe and tubing with the fast, reliable, economical low-temperature silver brazing alloys EASY-FLO and SIL-FOS. It tells how to — cut and fit — clean — flux — support assemblies — heat and flow the alloys — clean after brazing. Write for a copy now. Ask for BULLETIN 17.

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with Mundet Custom Molded 85% Magnesia

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Now available in pipe covering and block insulation, Mundet Custom-Molded 85% Magnesia permits new heat-saving efficiency.

You benefit from these advantages when you use Mundet 85% Magnesia Insulation.

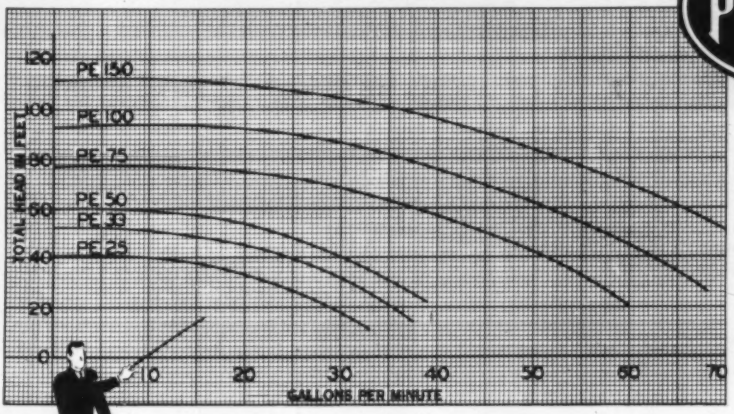
- ***Easier to Apply***
  It cuts easily and cleanly, even without canvas support. No chipping, crumbling or "powdering." Blocks score cleanly.
- ***Lighter Weight***
  Only 11 lbs. per cubic foot density. Even larger sizes and thicknesses are easy for one man to handle.
- ***Controlled Uniformity***
  Precision manufacture on the latest type of equipment insures uniform standards.
- ***More Durable***
  Greater "ductile strength" is built into the insulation. It does not "powder," settle or disintegrate even with heavy vibration. It withstands handling and may be removed and reapplied if necessary.
- ***Does not Shrink or Warp***
  Steam or water leakage does not affect it. It does not shrink or warp even after soaking.
- ***Attractive Smooth Finish***
  No unsightly, inefficient "bagging." Mundet 85% Magnesia insulation retains its neat appearance and effectiveness.
- ***Precision Pipe Fit***
  No spaces are left for the escape of heat. The whole heated surface is snugly enclosed.

Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7207 Tonnelle Avenue, North Bergen, N. J.

INSULATION FOR HIGH AND LOW TEMPERATURE

GRAPHICALLY ILLUSTRATING PEAK PERFORMANCE YOU GET WITH *FRACTIONAL* H.P. GENERAL PURPOSE PEERLESS FLUIDYNE END SUCTION PUMPS

PEERLESS PUMPS



KEY TO CHART

Performance chart showing head-capacity characteristics of Peerless Type PE Fractional H. P. General Purpose Pumps.

KEY TO PUMP H. P. IN CHART AT LEFT

PE 25—¼ hp
PE 33—⅓ hp
PE 50—½ hp
PE 75—¾ hp
PE 100—1 hp
PE 150—1½ hp

Part of a complete line of Electric or Belt Driven or Flexible Coupled Pumps for diversified services calling for transferring or moving liquids

SAME HIGH PERFORMANCE RATINGS CHARACTERIZE THE COMPLETE PEERLESS LINE IN ALL SIZES FROM ¼ H P. to 40 H.P. ALL TYPES OF DRIVE AVAILABLE

Here are other features of the Peerless line of fractional hp general purpose pumps that will appeal to you for most all your water moving requirements. In addition to its peak performance ratings, Peerless offers:

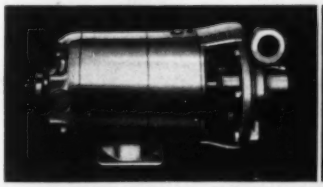
1. Four different types of drive—close coupled electric, V and flat belt pulley and flexible coupled with pump and motor on common base. You select the pump best suited to your needs from a head range up to 110 feet, from a capacity range up to 65 gpm and motor sizes up to 1½ hp.

2. Simplicity in design, reflected in easy installation, long efficient life, ease of maintenance and replacement of parts.

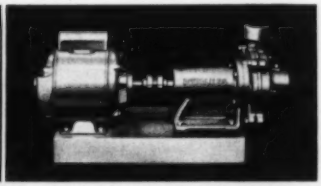
3. Most models and types available from stock, in standard construction.

4. Hydraulic characteristics superior to conventional pumps. Performance chart above illustrates the excellent efficiencies over the entire operating range of the fractional hp line.

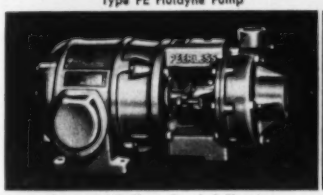
5. Non-overloading impeller design, helping to prevent motor burn-out due to fluctuations under operating conditions.



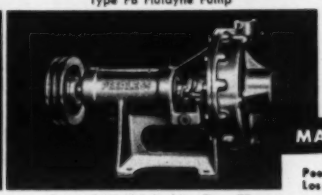
Fractional HP Close Coupled Electric Type PE Fluidyne Pump



Fractional HP Flexible Coupled Type PB Fluidyne Pump



Integral HP Close Coupled Electric Type PE Fluidyne Pump



Integral HP V-Belt drive Type PB Fluidyne Pump

NEW BULLETIN

describes additional features of both fractional and integral hp pumps in the Peerless Fluidyne Line. Write for your copy of this 24-page fully illustrated and descriptive bulletin by mailing coupon today.

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Peerless Pump Division
Los Angeles 31, Calif.

Please send without obligation new Bulletin B-2300 describing Fluidyne line of fractional and integral hp pumps.

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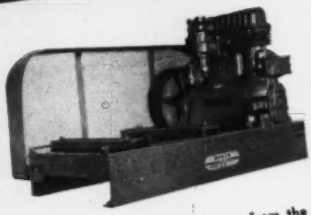
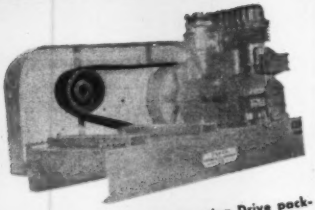
Announcing....

a new concept

HOW THE BAKER MRU LINE IS ENGINEERED

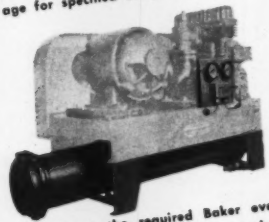


1. Select the right compressor from the famous Baker freon line.

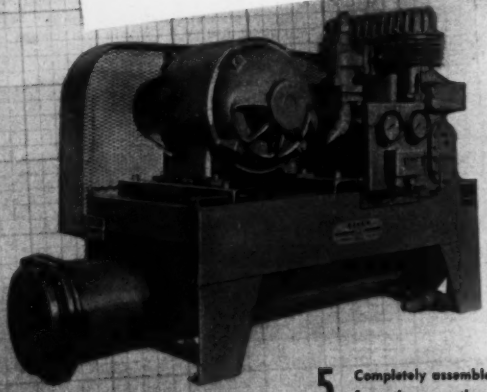


2. Add the right connecting Drive package for specified compressor speed.

3. Then add the proper motor to meet individual power characteristics.



4. Choose the required Baker evaporative or shell and tube condenser and gauge board.



BAKER MRU* LINE GIVES YOU THESE ADVANTAGES

1. Custom-fitted to each job
2. Prompt, faster delivery
3. Perfectly matched to the load
4. Easier to install at the site
5. Quick, precise assembly
6. All fittings included
7. Increased capacities easily achieved
8. Longlife—low maintenance

5. Completely assembled, you are assured of the one *right design* from the more than 1,000 variations of Baker MRU machines.

in refrigeration units

The New

Baker MRU* Freon Line

**Multiple Refrigeration Unit*

HERE at last is a modern refrigeration unit so flexible in design that it provides *every* component exactly as you want it . . . custom-fitting the machine to the requirements every time!

No matter how strict the specification, or what the power source, or what the application, the Baker Multiple Refrigeration Unit freon line permits complete freedom of selection of the proper equipment to make it the one right unit for the job.

Designed on a simple "building block" principle, Baker MRU machines are shipped from the factory for easy field assembly. All components . . . compressor on steel stand, drive package, motor, gauge board, condenser, etc. . . . are held in stock ready to be shipped promptly to the site to meet your specifications exactly. Each MRU component fits readily and easily into the whole. All fittings are included. No special tools are needed.

The Baker MRU Freon Line gives you over 1,000 designs . . . each one literally custom-tailored to assure you of maximum satisfaction and the most efficient operating performance without compromising the equipment to the job.

Baker Refrigeration Corporation, South Windham, Maine — Omaha, Nebraska

Now Ready! **Send for full information on the Baker MRU Line!**

Baker Refrigeration Corporation
South Windham, Maine

Tell me more about the flexibility of the Baker MRU Freon Line.

NAME_____

TITLE_____

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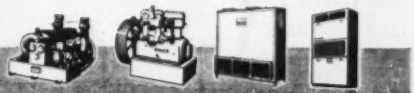
CITY_____ STATE_____

Baker

AIR CONDITIONING and REFRIGERATION



What wall space height has least flue action?

Laboratory tests at Massachusetts Institute of Technology and elsewhere reveal that reducing the HEIGHT of 4″ and thinner air spaces below 3 ft., increases the flow of heat and reduces the space's insulation value.

Increasing the height of the wall space increases the amount of surface resistance to convection currents, until at 36″ this resistance is greater than the convection. Beyond 36″, there is little change.

For this reason, the air spaces in multiple accordion aluminum Infra wall insulation are made to run up and down instead of horizontally. Type 6 Infra Insulation in walls has a C factor of .073 and a Resistance of 13.69. Type 4 Infra in walls has a C factor of .105, a Resistance of 9.52. The equivalents in *laboratory*-dry rockwool are 4½″ and 3½″ respectively.

"Wall Heat Flow," a chapter in "Simplified Physics of Vapor and Thermal Insulation" describes the tests cited above. A copy of this authoritative manual may be obtained free by filling out the coupon below.

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10 Murray Street
New York, N. Y.
COrtlandt 7-3833

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Name_____
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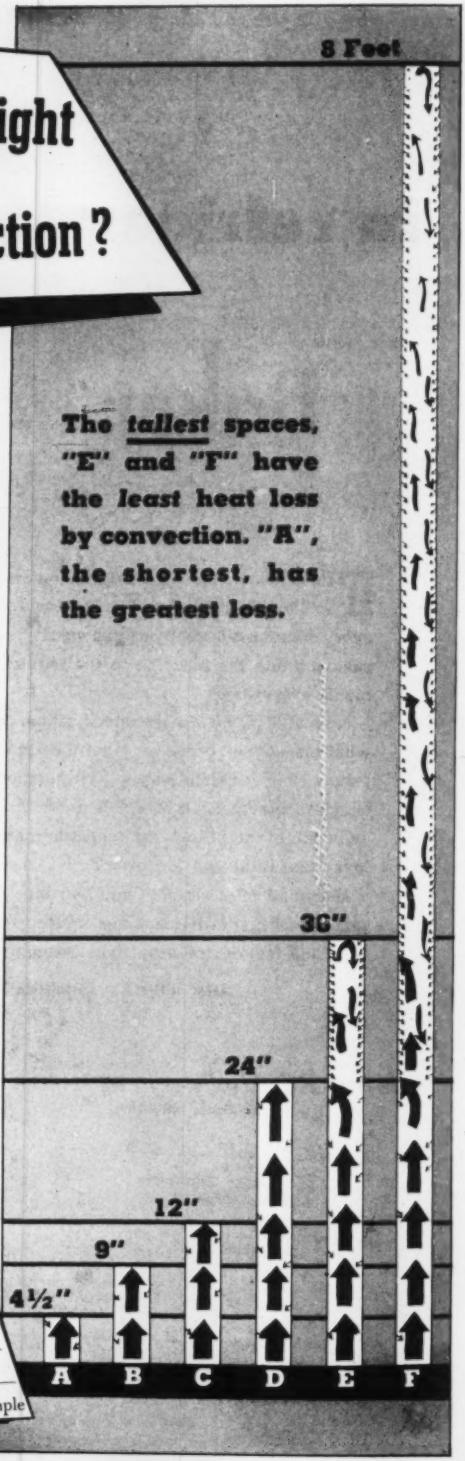
☐ Send Prices of Infra Insulations ☐ Send Sample



THE EDITOR'S PAGES

• LAST MONTH'S Show Section in Heating, Piping & Air Conditioning "previewed" the 10th International Heating, Ventilating & Air Conditioning Exposition in Philadelphia and the 57th annual meeting of the American Society of Heating and Ventilating Engineers in the same city. As usual, the official proceedings of the ASHVE meeting will appear in the ASHVE Journal Section, which is published each month in HPAC. . . . Several of the papers presented at the meeting have already been published in the Journal Section, there are others this month, and the rest will follow. . . . New products and improvements displayed at the exposition, and which have not already been described in our columns, will be covered in our regular Equipment Developments department. . . . . Last month's issue of Heating, Piping & Air Conditioning (the biggest in history) also carried the annual Directory Section, which is compiled and published for your use throughout the year. If you fail to find any information you are looking for in this Directory Section during the year, we'd certainly appreciate your dropping us a line so that we can remedy the omission in the printed Directory Section next January (and, in the meantime, give you, if possible, the information you seek). Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2. . . . . Our volume index for 1950 is in preparation, and if you have requested a copy it will be sent you as soon as it comes from the printer.

78% OF HOSPITALS HAVE OR PLAN CONDITIONING

ON THE BASIS OF 513 replies to a mail questionnaire on the subject of air conditioning, 295 hospitals or 57 percent of the total have air conditioning in some part of the hospital, while 106 or 20 percent of those reporting indicate that they plan to install air conditioning, says Modern Hospital magazine. This group of 106 planning to install air conditioning constitutes nearly half (48 percent) of hospitals reporting no air conditioning at the present time.

Of the 295 hospitals now having air conditioning in some areas of the hospital, 223 or 75 percent reported air conditioning in surgery, with about half that number reporting air conditioning in delivery rooms and nurseries. Of those planning air conditioning, approximately 90 percent state that they will use it in surgery.

The obstacle to air conditioning installation most frequently mentioned was that of cost, and the second most frequent objection was operation and maintenance expense. Those objections expressed by hospital administrators coincided in relative importance with the objections expressed by architects in a similar study made concurrently among this group.

The study among architects is derived from 165 questionnaires returned from a mailing to currently active hospital architects. That surgery is the most important area for air conditioning, which was indicated by hospital administrators, is confirmed by the opinion of architects, who place surgery first among all hospital departments in which air conditioning is essential.

IMPROVES FAN TESTING TECHNIQUES

IMPROVED, lower cost equipment, which is intended to aid fan manufacturers in reducing testing costs in product engineering operations at their plants, has been developed by W. D. Scoates, assistant research engineer, Texas Engineering Experiment Station. It permits prototype fan testing by a single operator in one-third the time required by conventional equipment.

Present accepted standard (National Association of Fan Manufacturers' code) fan testing equipment requires two operators and a 20 point traverse of a supply air duct—10 duct diameters in length, according to the Texas Engineering Experiment Station News, College Station, Texas.

The new equipment uses an orifice plate as its air measuring device, and it can be somewhat economically constructed. It consists primarily of two airtight rooms with an orifice plate between them. The fan to be tested blows into the first room, and an exhaust fan or blower discharges the same air from the second room after pulling it through the orifice plate. The quantity of air is measured by the pressure drop encountered in pulling the air through the orifice. This pressure drop can be measured on a manometer in a single reading, thereby eliminating the necessity for a 20 point traverse, which simplifies reading and calculating.

COOLING TOWER INSTITUTE FORMED

THE PRACTICAL encouragement of all efforts, both governmental and private, toward the conservation of water as "America's No. 1 natural resource" has been announced as the primary objective of the newly-formed Cooling Tower Institute, according to Raymond C. Kelly, its president. Other objectives of the institute are to support cooperative research toward improving the technology, design and performance of industrial water cooling equipment; coordinate recognized engineering groups in developing standardized testing procedures acceptable to manufacturers, users and technical groups; establish minimum standards of construction; and accumulate technical data of interest to both

Front Cover Photo

A SNOW MELTING SYSTEM installed in 1949 under the sidewalk in front of Pittsburgh's Union National Bank paid handsome dividends in record 31 in. snow. A hot water and antifreeze solution carried through wrought iron pipes just under the surface of the pavement did away with the need for snow shovels. After the storm, the bank's president, C. L. McCune said, "The use of sidewalk heating is so obvious and practical a solution to the snow and ice problem that I can't imagine anyone erecting a new building without including it." (Photo courtesy A. M. Byers Co.)

manufacturers and users of industrial water cooling equipment.

Speaking on the formation of the CTI, Mr. Kelly said, "Emerging in the early 1930's as a separate and distinct industry devoted directly to the conservation of water, the cooling tower industry has grown more than ten-fold in 20 years and today finds itself a full-fledged member in the family of major industries. Although the present membership represents the majority of the manufacturing capacity for industrial-type equipment, we hope eventually to encompass the entire field of both evaporative water cooling and the new air cooled heat exchangers."

The member companies, their present delegates, and the CTI officers elected for the first term are: Fluor Corp., Ltd., J. R. Fluor, (First Vice President CTI); Foster-Wheeler Corp., J. A. Brown, (Second Vice President CTI); Hudson Engineering Corp., N. B. LauBach, (Delegate CTI); Lilie-Hoffmann Cooling Towers, Inc., P. R. Hoffmann, (Delegate CTI); Marley Co., Inc., L. T. Mart, (Secretary-Treasurer CTI); J. F. Pritchard & Co., Raymond C. Kelly, (President CTI); C. H. Wheeler Mfg. Co., H. R. Baker, Jr., (Delegate CTI).

AIR SANITATION SOLVES MICROWAVE RADIO PROBLEM

AIR SANITATION plays an important part in assuring reliable reception and transmission in the nationwide network of microwave radio repeater stations developed by the Bell Telephone Laboratories for the American Telephone and Telegraph Co., says the W. B. Connor Engineering Corp. Microwave energy is picked up at a repeater station, amplified and rebroadcast to the next adjacent repeater station. These radio facilities are used to transmit broad-band communication signals involving hundreds of telephone messages and also serve to distribute television programs on a nationwide basis.

Certain vacuum tubes, either in "cavities" or exposed in each equipment frame, require a steady stream of cooling air for the best operating efficiency. Each station has a single air pressure source consisting of two multistage turbine type blowers. One blower operates from commercial a-c, and the second is a battery operated standby unit.

"QUOTE"

"To carry on this essential military and defense work and still produce as much as possible for civilian consumption, Westinghouse—like most other companies—is in a far better position than at the beginning of World War II. In dollar volume, the company's production in 1950 was nearly four times as great as in 1940. In the past five years alone—since the end of World War II—its manufacturing floor space and equipment have been increased by approximately 50 percent.

"According to government figures, American industry has spent some $83 billion for new and improved plants and equipment since the end of the last war. This country now has a production potential greater than all the rest of the world."
—GWILYM A. PRICE, President, Westinghouse Electric Corp., in a recent "year-end statement."

During the early development period of this project it was found that the temperatures within identical cavities were varying over a wide range. Investigation showed the temperature variations to be directly related to the quantity of air entering the cavities. Inspection of the cavities revealed comparatively large deposits of dirt in the air passageways and on the vacuum tubes which resulted in the restriction of air flow and gave every indication of complete stoppage under continued operation.

Analysis of the deposited dirt showed two conditions: That the dirt was a coagulation of microscopic particles, and that sulphides in the air were combining with the silver plating of the inner cavity surfaces to produce silver sulphide. The result was a flaky layer composed of dirt and silver sulphide.

Although the initial design of blowers provided two filters, these were only capable of removing the heavier dirt particles and were for all practical purposes useless for removing the microscopic particles which were combining and being deposited in the small passageways where the air traveled at higher speeds. The necessity of correcting this situation led to the introduction of an efficient barrier type of filter material immediately after the original filter. This material has produced results in this application "comparable to that which would be expected of electrostatic filters."

These measures solved the dirt problem and the solution to the second problem appeared to be one of supplying air free from sulphides. A filter was devised which effectively removes the sulphides from the air before being distributed to the various vacuum tubes. It consists of a bed of activated carbon 1-1½ in. thick, held between two meshed screens and supported in a frame.

The blower system has a maximum capacity of approximately 40 cfm of air operating against a total static pressure of 5 in. water gage. When operating at this capacity it is expected that there will be less than ½ in. pressure drop across the combined filters.

COULD HAVE BEEN "BEST IN HISTORY"

HAD PEACE PREVAILED in the world, 1951 would have been the best in the history of the air conditioning industry, Cloud Wampler, President of Carrier Corp., believes.

However, the needs of the national defense program unquestionably will curtail the ability of the industry to meet so-called civilian demand — a demand that ran at high tide in 1950.

On the other hand, he pointed out, the experience of World War II clearly demonstrated the necessity of air conditioning and refrigeration for purposes of increasing human efficiency, improving or making possible vital industrial processes and in direct service to the armed forces. Consequently, the present outlook is that this industry will continue to devote much of its capacity to the production of familiar goods, he stated.

Looking specifically at the prospects for Carrier Corp. in 1951, present expectations are these, Mr. Wampler said:

1) That a substantial volume of business will be done in the manufacture and sale of equipment normal to the corporation.

2) That direct government contracts, both in and out of this field, will increase as the year progresses, adding to several such contracts now being executed.

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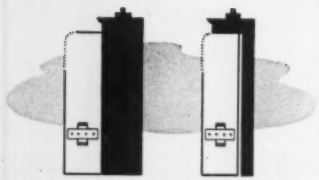

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• DO YOU HAVE something you'd like to say about any of the articles published this month? An additional comment, or perhaps a question on some point? Or do you want to express your views on some matter of interest to heating, piping and air conditioning engineers or contractors? We follow here the practice at engineering society meetings of providing an "open for discussion" period. You are invited to participate. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

REGULATING WATER USE FOR AIR CONDITIONING

[Editor's Note—The following comments must be recognized as coming from the writer as an individual and not as a spokesman for the AWWA committe.]

SINCE DIRECT conflicts of interest are involved, the American Water Works Association report on regulating use of water for air conditioning, published in the January HPAC, is open to two widely divergent points of view. One extreme which cannot be completely avoided is that it brings out into the open, the threat of regulation—or to use the more provocative expression, the threat of restriction. Events of the last few months indicate that one of the first normal reactions is that of singling out relatively small parts for criticism. Such attacks have already occurred and have delayed the publication of the report for almost half a year.

The other extreme is the concept that the air conditioning industry might well have some interest in doing whatever is within its capacity to see that the purchasers of its equipment have a reasonable assurance of continuity of water supply —that they will not be deprived of use of their equipment when it is needed the most. Threats of deprivation, and actual deprivation (the latter for brief periods) are now matters of history. They give evidence that continuity of supply under all conditions and in all places cannot be taken for granted and that certain communities are drifting into situations in which they should either avoid new commitments beyond their capacity to deliver or should take measures to increase a capacity that is shrinking in relation to the demands upon it.

An intermediate and constructive point of view is that regulation, although distasteful, should be applied where protective measures are necessary—and should not be applied where they are unnecessary. Which one of the two may be in order is a matter in which generalizations can be grossly misleading. The problem is, therefore, to determine first where and when and then, if necessary, how—and separately for each individual community.

The AWWA report deals primarily with the "how". According to the task assigned to the committee, it is limited to the use of water by air conditioning and refrigeration and, therefore, does not deal with other uses to which measures of conservation should also be applied. As such, it is obviously of limited scope and must be looked upon as only one of the several necessary steps toward the solution of the problem of water conservation.

Past practices throw light upon this point. In general, their broad pattern has been that a governing body decides that the use of water by air conditioning must be regulated, then obtains copies of regulations that are in effect in other cities and uses them for guidance, and then holds more or less hurried public hearings at the last minute.

Two parts of this procedure are unfortunate. One is that air conditioning alone is singled out for regulation and the other is that most of the previously written regulations require water conserving equipment for packaged units of 5 tons and up. This is obviously the hottest and toughest part of the whole problem. Units of from 5 to 10 tons capacity are being sold at such a rate that, without conserving devices, they can be responsible for a large part of both peak water demand and water usage. The economics of applying water conserving devices to the 5 to 10 ton range are vastly different from those applying to single systems and much greater capacity.

The "model" ordinance given as an appendix to the AWWA report recognizes this economic situation by including a third range of capacity (Item 7.2 in Section 7) between the two ranges to which nearly all existing regulations have been limited. The idea is that in one community the increasing demands of these small units for water can become a threat to the adequacy of supply; that in another, the same units provide an opportunity for the sale of more water. A hundred 5 ton units widely distributed throughout a community should be less apt to create bottlenecks in distributing mains or sewers. The balance between the two is a local problem.

The foregoing is one of several important perspectives upon which too much emphasis cannot be placed. Another is that the report makes real progress toward a brief statement of the problem and an outline of approach. The "model" ordinance is merely an appendix to the report and by the use of blank spaces instead of figures deliberately avoids proffering solutions to the problem. The two combined emphasize the fact that the only good solution must be based upon the facts with which each individual community is confronted. —L. L. LEWIS, Vice President, Carrier Corp.

REDUCING AIR EXHAUST OF LABORATORY FUME HOODS

JOHN F. TURNER, in his article in the January HPAC on exhaust systems for laboratory fume hoods, brings out several points which are important in reducing the maximum heating and cooling load in the laboratory and keeping the size of air con-

ditioning apparatus at a minimum. Much of the heating and cooling load is due to the amount of air required by the hoods. Using the bypass damper as shown by Mr. Turner results in a constant air consumption per hood regardless of whether the hood doors are open or closed.

While this may be acceptable in many instances, there are other cases in which it is desirable to economize still further in the use of air, in order to reduce the heating or cooling load chargeable to the amount of air required by the hoods, or to reduce the load on the filters.

The first reason requires no further explanation. Regarding the second, it should be remembered that many laboratories are dealing with radioactive or highly toxic materials and that the special air filters required are expensive to purchase and difficult of disposal.

To accomplish this further reduction in air consumption by the hoods, yet maintain the required face velocity through the door regardless of opening, a throttling damper is installed in the hood exhaust duct in place of the bypass damper previously mentioned. This throttling damper usually is actuated by a velocity controller which responds to the unbalance in static pressures inside and outside of the hood. Other means of controlling the throttling damper could include instruments responding directly to velocity. These require that the sensing means be located in the plane of the door, where they usually interfere with the operator, or in a special sampling hole cut in the side or top of the hood.

These throttling dampers also have been operated by mechanical linkage with the hood doors. This becomes very difficult when there is more than one door per hood. Some hoods have as many as five or six doors. Furthermore, even if a mechanical linkage could be designed to give the proper relationship between door opening and damper position, this relationship would hold only so long as the characteristics of the duct system remained constant. Bearing in mind that the filter resistance will change with use, it is readily seen that a mechanical arrangement at best will give only approximate control of velocity.

Regardless of the means of operating the throttling damper in the hood exhaust duct, the fact that the amount of air exhausted through the hoods is variable in accordance with door openings means that there must be a variable air supply to the laboratory. Since it generally is desirable to keep the pressure in the laboratories negative with respect to the rest of the building (to prevent contamination of otherwise safe areas), the quantity of air supplied to the laboratories is controlled by a static pressure regulator responding to the difference between laboratory and general area pressures.

With the arrangement described herein using a throttling damper in the exhaust duct operated by a velocity controller of the unbalanced pressure type, the velocity through the hood doors can be controlled within close limits. The amount of air introduced into the laboratory is only that required to maintain the desired face velocity through the hood doors. Since the hood doors are kept closed as much as possible for reasons of safety, this results in a considerable saving in the amount of air supplied, with proportionate reductions in heating and cooling demand, and considerably longer filter life. — H. W. Alyea, Chief Field Engineer, Johnson Service Co.

CONTROLLING PUMP FROM BOILER WATER LEVEL

For those readers who checked the schematic wiring diagram in Fig. 3 of my article, Control Pump from Water Level To Improve Boiler Operation, published in the December HPAC, it will be noted that the circuit to the electric valve associated with the upper boiler was not completed as intended.

The lower boiler diagram is correctly indicated, whereby each time the electrical circuit to the pump is closed the respective electric valve on the boiler needing water is open. —John W. James, Chief Research Engineer, McDonnell & Miller, Inc.

DOES RADIANT HEATING AFFECT WOOD FLOORS?

In the Question of the Month columns of the January HPAC, Paul S. Park, Jr., has presented an informative article on the subject of the use of wood floors with radiant heating floor panels, and we are in full agreement with the points that he has made.

Mr. Park states that when heating pipes are suspended in air the characteristic known as emissivity becomes quite important. This, of course, is true but it might be added that in the case of copper tube in its natural condition the emissive film coefficient is very low. This is a fact that should be faced and we feel quite sure that no manufacturer would recommend the use of his products under unsuitable conditions.

We not only concur in the conclusion that Mr. Park reaches, but here again we would go further than he does. When we are asked to give an opinion on the use of wood flooring for a radiant heating floor panel, we generally advise against it in three short words — namely, "Don't do it." We maintain that radiant heating is not the answer for all cases and wherever suitable conditions for radiant heating cannot be provided, then some other type of heating system should be used.

Even though a system were properly designed with the radiant heating coils in a dead air space below wood flooring, it would represent a relatively inefficient and, therefore, uneconomical condition because of the very poor heat transfer conditions from the heating medium in the coils to the occupied space. It is our belief that where there is insistence on the use of floor coils with wood flooring, it is due to an insufficient knowledge of the basic principles of radiant heating. This generally leads to the common, though incorrect, belief that in order to produce warm floors it is necessary for the heating coil to be located in the floor

There is another point that Mr. Park has not referred to which may be of interest — namely, that where pipe coils are installed in an air space for heat transfer purposes, pipe size is of considerably more importance than is the case where the piping is embedded. The surface characteristics of the pipe (such as color and texture) are also significant but have little effect when the pipe is embedded.

Incidentally, use of the word "tube", either in the singular or plural sense, is preferred to "tubing", according to the terminology section of the Standards issued by the Copper and Brass Research Association. —D. L. Mills, Research Dept., Revere Copper and Brass Inc.

In these times of scarcities it is more than ever important to remember that two or more heads are better than one. Your suppliers, for example, know a great deal about the materials they handle, how to select, specify and install them.

No matter what you buy it will pay you to draw upon this knowledge. It may help you make scarce materials go further, reduce costs of installation, perhaps even suggest a substitute.

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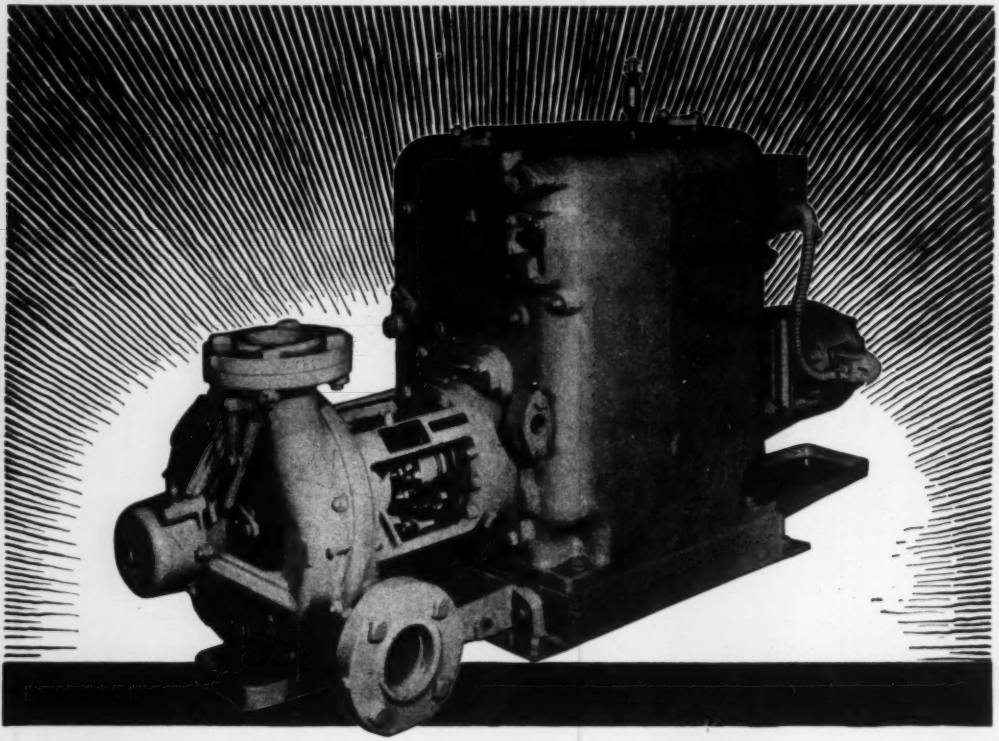

For service in greenhouses, hospitals, schools, theatres, and public buildings, where heat failure is a serious matter, the Nash Vapor Turbine Return Line Vacuum Heating pump should be specified, for this pump operates perfectly without electric current.

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This pump insures constant heat in the system, it eliminates electric current cost, and it promotes high efficiency in the heating system. Heating efficiency is due to the fact that this pump can operate continuously with economy. Continuous operation means uniform circulation, and uniform conditions in the system mean steam saving.

This pump has but one moving part, no internal wearing parts, and requires no internal lubrication. Bulletin D-246 tells all about it, and it is free on request.

THE NASH ENGINEERING COMPANY

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How to Select A-C Motors for Heating and Air Conditioning

C. P. Potter, chief engineer of the electrical div., Wagner Electric Corp., reviews in easy-to-read style available types of alternating current motors and their characteristics, with particular attention to their application in heating, ventilating and air conditioning service. He includes information on methods of starting motors. His remarks on where motors of various types are used are especially practical and helpful

IN THE EARLY days of alternating current development in this country, distribution circuits were usually single phase, operating at 133 cycles, and motor usage was thus limited to single phase applications. Since squirrel cage induction motors are simple in construction and economical to manufacture it would have been highly desirable to use them for such service, but unfortunately single phase squirrel cage motors have no torque at standstill—although they have very satisfactory torque characteristics at speeds close to synchronous speeds.

Fig. 1 shows the speed-torque curve of a single phase squirrel cage motor and illustrates graphically why special methods must be used for starting motors of this kind. Various methods of starting single phase motors have been developed, and today a standard motor that will meet the requirements of the application can usually be obtained. Those types of single phase motors most generally used in the air conditioning industry will be discussed in the first part of this article, and polyphase motors will be discussed in the second part.

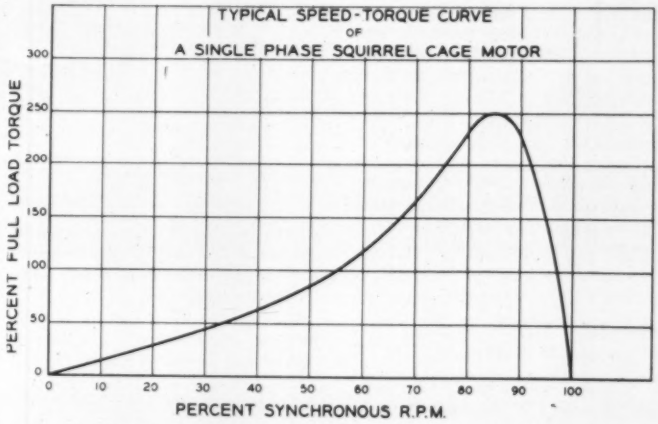


FIG. 1—WHY SPECIAL methods must be used for starting single phase squirrel cage motors is illustrated by this typical speed-torque curve, which shows no torque at standstill

Split Phase Induction Motors

The simplest type of single phase motor is the split phase motor, which has been in use for a long time. A split phase motor is built with a squirrel cage rotor (Fig. 2) and two stator windings which are spaced 90 electrical degrees from each other. In other words, the poles of the auxiliary winding are halfway between the poles of the main winding, Fig. 3. At the time of starting, the

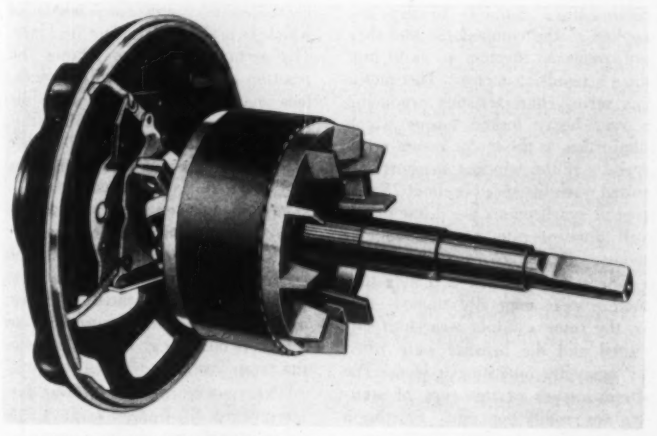


FIG. 2—SPLIT PHASE induction motor has a squirrel cage rotor, as shown here with its quick break switch, and two stator windings which are spaced 90 electrical degrees from each other

main and auxiliary windings are connected in parallel across the line. The auxiliary winding is wound with wire much smaller and therefore of higher resistance than that used in the main winding. The high resistance auxiliary winding produces a small starting torque which causes the motor to start and come up to speed provided the load is not too great. When the rotor reaches about 75 percent of synchronous speed, a centrifugal switch opens the auxiliary winding circuit and disconnects the auxiliary winding from the line. If it were not disconnected from the line, the auxiliary winding would be destroyed in a very short time because of the heat produced in it by the high current density.

Split phase motors have low starting torque and high starting current and therefore are seldom built in sizes larger than 1/3 hp. They are used for operating fans, unit heaters and oil burners. Split phase motors designed with higher starting torque and current are used for operating washing and ironing machines which start infrequently. Split phase motors should not be used for driving blowers which have considerable inertia and, therefore, a long starting period.

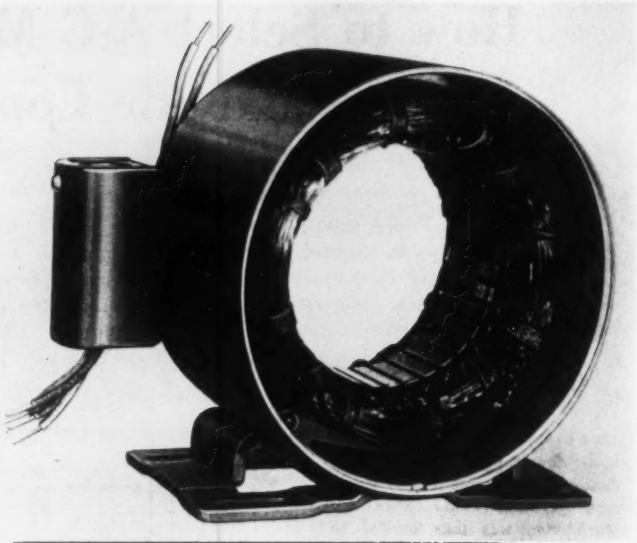


FIG. 3—STATOR AND stator frame for a typical split phase motor, showing the main and auxiliary windings. At time of starting, main and auxiliary windings are in parallel

Repulsion Start Induction Motors

The first commercially successful single phase motor to be built in the larger fractional and integral sizes was the repulsion-start induction motor. This motor has a winding in the rotor which is connected to a commutator. Suitable brushes are applied to the commutator and they are connected together so as to produce a repulsion motor. This motor has series characteristics producing a very heavy locked torque which diminishes as the motor comes up to speed. If the winding is short circuited when the speed is about 75 percent of synchronous speed, the motor will then operate as an induction motor.

The early repulsion-start induction motors were manually started—that is, the rotor winding was short circuited and the brushes were lifted by manually operating a lever. The disadvantages of this type of starting are readily apparent. Starting a large number of these motors several times a day was a very laborious operation, because it was necessary to attend each motor every time it started and most of the times it stopped, the latter trips being made to restore the mechanism to its starting position. Necessity being "the mother of invention," a governor mechanism or centrifugal device was soon perfected which took care of these operations automatically.

Fig. 4 shows cross sections of a rotor taken from a modern repulsion-start induction fractional horsepower motor and illustrates the winding connected to a commutator, inside of which is a short circuiting necklace. The section at the top shows the position of the short circuiting necklace and the brush mechanism while the motor is starting. During this period, the short circuiting necklace is not in contact with the commutator and the motor operates as a repulsion motor. When the motor reaches a predetermined speed, the governor mechanism operates pushing the spring barrel forward, and the necklace flies out, due to centrifugal force, connecting the commutator bars to the short circuiting ring as shown in the lower section.

This type of construction was formerly used for rather large single phase motors which were built in ratings up to 50 hp until polyphase circuits were available. Repulsion-start induction motors are still very popular in sizes 5 hp and smaller, because they have two very desirable characteristics—low starting current and high starting torque. They can be used on practically all applications, including compressors, pumps, stokers, blowers, etc. Fig. 5 is a cutaway view of a fractional horsepower repulsion-start induction motor.

Capacitor Start Induction Motors

By modifying the auxiliary winding of a split phase motor and connecting a capacitor in series with it, the starting characteristics of the motor are very much improved. This was known for a long time, but capacitor-start induction motors did not come into general use until it was possible to obtain electrolytic dry-type capacitors which were comparatively small, inexpensive and reliable. These capacitors are now available and a great many capacitor motors are being built and used especially in the fractional horsepower sizes. They are used interchangeably with repulsion-start induction motors but have considerably higher starting current and lower starting torque than the repulsion start motors. Fig. 6 is a cutaway view of a capacitor-start induction motor.

Capacitor Start-and-Run Induction Motors

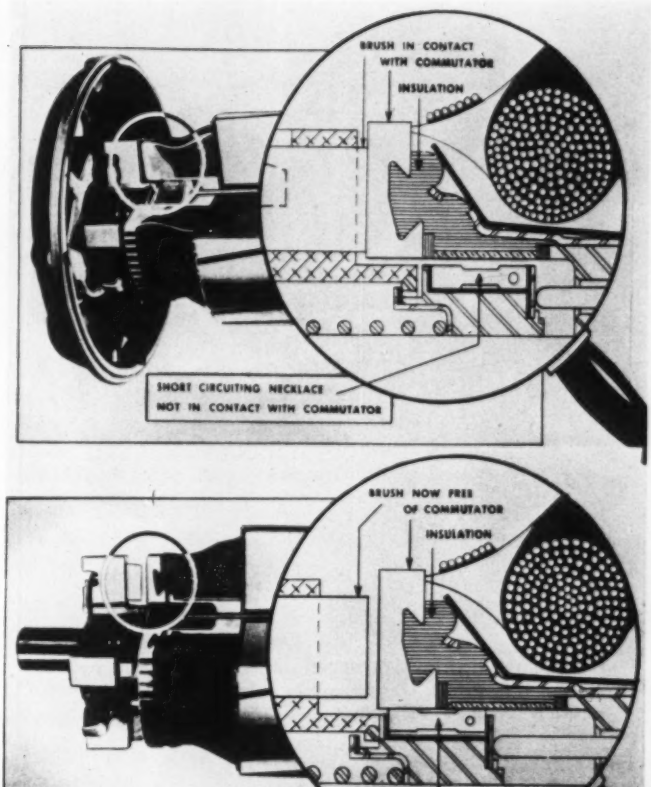
The capacitor start-and-run motor is a modification of the capacitor start motor. It has an electrolytic capacitor which is in series with the auxiliary winding only during the starting period, and a liquid filled capacitor which is permanently in series with the auxiliary winding, thus requiring the use of larger wire in the auxiliary winding than is needed in a capacitor start motor. The heavier winding and the liquid filled capacitor add to the cost of the capacitor start-and-run motor but improve its starting and running characteristics considerably. The noise produced by a capacitor start-and-run motor can be reduced to a minimum by selecting the proper size of running capacitor. This type of motor is quite popular in the integral horsepower sizes where quiet operation is important. The rating of the running capacitor should be selected for the actual load in order to obtain the best results.

Permanent Split Capacitor Induction Motors

Another type of capacitor motor which is used in heating, ventilating and air conditioning is the permanent split capacitor motor, which has one capacitor for both starting and running conditions. This motor has no centrifugal switch but the capacitor is permanently connected in series with the auxiliary winding. This type of motor has a very low starting torque and is used mostly for driving fans or blowers which are mounted directly on the motor shaft. It can be made to operate very quietly because of the running capacitor.

Shaded Pole Fan Duty Induction Motors

Small direct connected fans used on air conditioning equipment are usually driven by shaded pole motors which are built in ratings up to about 1/15 hp. Starting torque is developed by induced current flowing through copper shading coils which set up a magnetic field out of phase with that produced by the stator coils. This phase displacement furnishes sufficient torque to start the light loads for which shaded pole motors are recommended. Acceleration is gradual, an important factor in direct connected propeller fan applications.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INSULATION
SHORT CIRCUITING NECKLACE NOT IN CONTACT WITH COMMUTATOR
BRUSH NOW FREE OF COMMUTATOR
INSULATION
SHORT CIRCUITING NECKLACE HELD TIGHTLY AGAINST COMMUTATOR BY CENTRIFUGAL FORCE

FIG. 4—REPULSION-START induction fractional horsepower rotor, showing at top starting position of short circuiting necklace and brush mechanism, and at bottom running position

The cast aluminum squirrel cage rotor is the only moving part in these motors; no governor mechanisms, brushes or switches are required.

Repulsion vs. Capacitor Start Motors

Some manufacturers and users prefer repulsion start motors while others prefer capacitor start motors. Comparing the two types, the capacitor-start induction motor is provided with the same type of centrifugal switch as is used in split phase motors, and while this mechanism is simpler than the one used in repulsion-start induction motors, nevertheless it has moving parts, bearing surfaces and contacts which are subject to wear and deterioration. Furthermore, while the electrolytic capacitor is fairly reliable, it too, is subject to failure. Comparing the reliability of repulsion start motors and capacitor start motors, both have governor mechanisms, the repulsion start motor has brushes which are subject to wear and the capacitor start motor has a capacitor which is subject to deterioration and eventual failure. For all practical purposes, both motors are available in the same ratings, both are thoroughly reliable and will operate satisfactorily for many years with very little attention.

Performance of Single Phase Induction Motors

Permanent split capacitor motors have very low starting and pull-in torques, about 50 percent of full

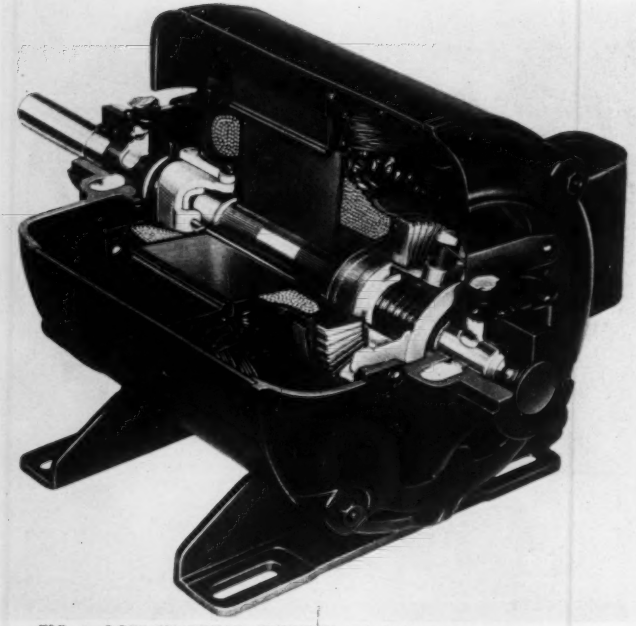


FIG. 5—LOW STARTING CURRENT and high starting torque are two desirable characteristics of repulsion-start induction motors, make them popular in sizes of 5 hp and smaller

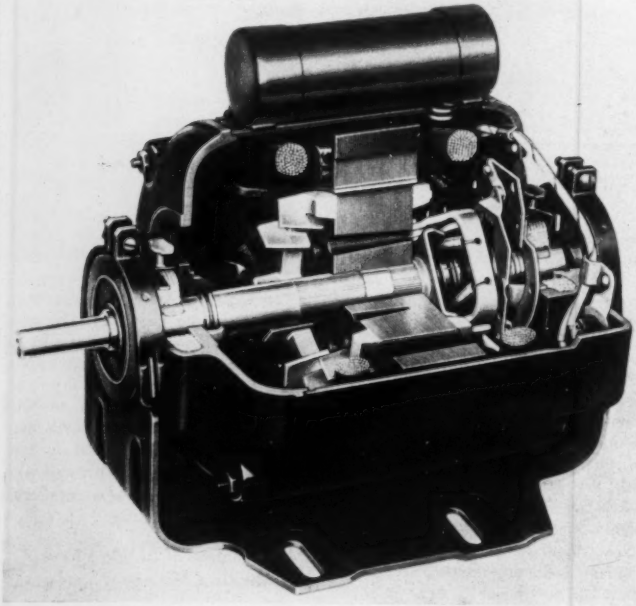


FIG. 6—CAPACITOR-START induction motors are used interchangeably with repulsion-start induction motors but have considerably higher starting current and lower starting torque

load torque, a rather low full load speed, and should be used only for driving fans or blowers which are mounted directly on the motor shaft. They should not be used for driving fans or blowers which are belted to the motor, as the torque required for accelerating the load may exceed the starting torque developed by the motor. Split phase motors have starting and pull-in torques from 150 to 230 percent of full load torque and may be used for driving belted fans provided the period of acceleration is not too great. Capacitor start and capacitor start-and-run motors have starting torques from 350 to 450 percent of full load torque, pull-in torques slightly more than 200 percent of full load torque, and are suitable for practically all applications. Repulsion start motors have starting torques from 350 to 550 percent of full load torque, slightly less pull-in torques than capacitor start motors, and are also suitable for practically all applications. Repulsion start motors have less starting current than any other type of single phase motor and should be used whenever low starting current is desired.

POLYPHASE MOTORS

As polyphase distribution circuits became available, the demand for the larger single phase motors began to diminish and the polyphase induction motor came into its own. Two kinds of polyphase motors were available at that time, squirrel cage and wound rotor.

Polyphase Induction Motors

Squirrel cage motors, Fig. 7, are simple and rugged. However, they have one disadvantage — the ratio of starting current to starting torque in a squirrel cage motor is comparatively high. The locked rotor current of polyphase motors 5 hp and larger is from five to seven times full load current with a starting torque of from 135 to 180 percent of full load torque; such a motor cannot be used when the distribution circuits are limited in size. The ratio of locked rotor current to locked rotor torque may be slightly reduced by increasing the resistance of the squirrel cage winding but such a procedure is not permissible in a general purpose motor because the additional

slip loss in the squirrel cage reduces the efficiency, increases the heating and results in high slip or in a heavy drop in speed from no load to full load.

It has been mentioned that wound rotor motors were also available in the early days of polyphase circuits. As the name implies, the rotor of a wound rotor motor has a wire winding terminating in collector rings. It is therefore possible to connect external resistors of suitable value in the rotor circuit, thus obtaining a starting torque equal to full load torque and with a locked current only slightly greater than full load current. When the motor comes up to speed, the resistors are short circuited, resulting in a motor of low slip and moderate heating, with only slightly poorer efficiency than a squirrel cage motor. The wound rotor type of induction motor has very good starting and running characteristics, but has the disadvantage of moving current-carrying parts, higher first cost and bulky control equipment.

Starterless Induction Motors

In order to eliminate the additional control equipment, a starterless type of motor was developed and was very popular for a considerable time. The rotor of this motor had a high resistance squirrel cage which limited the locked current to three times full load current, with a starting torque of 200 percent of full load torque. The rotor also had a low resistance winding which was open circuited at starting and which was short circuited when the motor came up to 75 percent of synchronous speed, by means of a mechanism very similar to the one used in single phase motors. The result was a motor with characteristics and cost between the squirrel cage and the wound rotor types which could be started by means of a single line switch. This motor automatically returned to the starting connection when power was interrupted, making it particularly adapted to automatic and remote control.

Double Squirrel Cage Induction Motors

In spite of the fact that the starterless motor had very good characteristics and low maintenance costs, its initial cost finally caused it to be superseded by the double squirrel cage motor. As the name indicates, this motor has two squirrel cage windings — a high resistance, low reactance winding near the rotor surface, and a low resistance, high reactance winding located below the surface. At the instant of starting, the rotor currents have line frequency and tend to flow in the low reactance outer winding, which, on account of its high resistance, produces a heavy starting torque with a fairly low locked current. As the rotor comes up to speed, the frequency of the rotor currents decreases and the reactive effect of the inner winding decreases, permitting this winding to carry its share of the current. The high torque, double squirrel cage motor has practically the same locked current as the single squirrel cage motor but has a starting torque of 200 to 250 percent of full load torque. The efficiency and power factor are usually lower than those of any of the types previously discussed, but on account of its ruggedness and cheapness, it has become very popular.

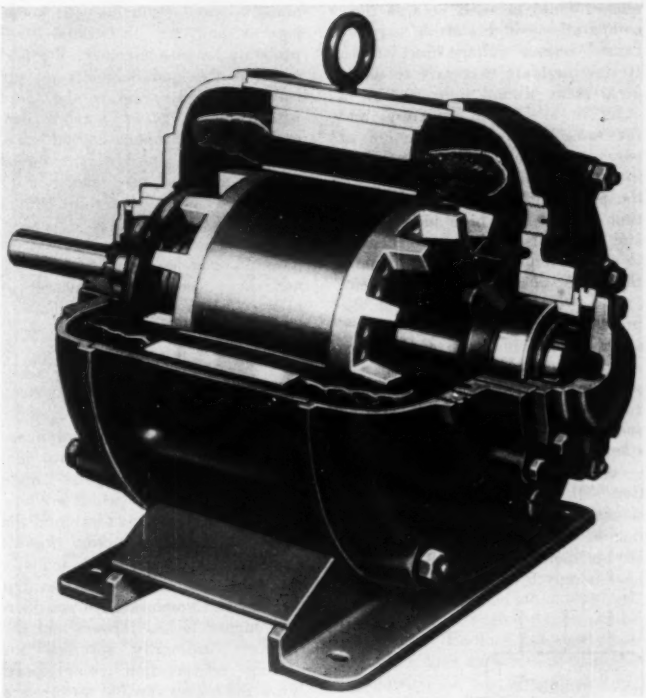


FIG. 7—POLYPHASE SQUIRREL CAGE motors are simple and rugged, but have the disadvantage of a high ratio of starting current to starting torque. This cutaway view shows construction

Multispeed Induction Motors

Multispeed motors are used when several definite speeds are needed. Both the squirrel cage or the wound rotor types can be built for multispeed operation, but very few of the latter are used on account of the high cost of the motor and the starting equipment. However, a considerable number of multispeed squirrel cage motors are used for various purposes. These motors can have a separate winding for each speed, the windings can be regrouped to obtain several speeds or a combination of these methods can be used.

Application of Polyphase Motors

The first polyphase distribution circuits were rather limited in size and only the smaller squirrel cage

motors could be used because their comparatively high starting currents caused serious voltage fluctuations. It was therefore necessary to use a great many wound rotor motors in order to avoid this difficulty, and for some years the production of wound rotor motors was about equal to that of squirrel cage motors. At the present time, however, distribution circuits have been increased in size until it is hardly ever necessary to use a wound rotor motor to obtain the benefit of its low locked current.

The wound rotor motor at the present time is used for variable speed service, but such applications should be made with caution. It must be remembered that if a wound rotor motor is to be used for variable speed service, the load must be constant and must be accurately known — otherwise, the desired speed variation will not be obtained. For instance, if a maximum speed reduction of 50 percent is desired and a 10 hp motor is applied when the load is only 5 hp, the maximum obtainable speed reduction will be 25 percent and the installation will probably be unsatisfactory. Furthermore, if the load fluctuates — say between 5 and 10 hp — the speed will fluctuate between 75 and 50 percent of synchronous speed and, again, the operation of the motor will not meet the requirements.

In some cases, wound rotor motors may be specified where speed *adjustment* and not speed *variation* is required. For instance, it may be necessary to operate a machine at high speed in order to accelerate a process, and then at a lower speed in order to finish the process. On such installations, multispeed squirrel cage motors and not wound rotor motors should be used.

As indicated previously, polyphase squirrel cage motors are of two general types — the original single squirrel cage motors (which are now known as design B motors) and the double squirrel cage motors (known as design C). Each has practically the same locked rotor current but the design C motors have considerably higher locked torques and are therefore ordinarily specified for driving refrigeration compressors. When the higher starting torques are not needed, the design B motor is used.

Multispeed motors may be either design B or design C and are built for either two, three or four speeds, and for variable torque, constant torque or constant horsepower service. If a motor has two speeds and one of the speeds is twice the other, it can be built with one winding, which is regrouped in order to obtain the speed change. If the speeds are not in the ratio of two to one, it is necessary to use two separate windings in order to obtain the two speeds. In some cases two windings are used, even though a single winding might be employed, in order to permit the use of cheaper and more simple control equipment. Three and four speed motors are almost always built with two separate windings, one or both of which can be regrouped.

Variable torque motors should be specified for fan service or any load which varies as the square of the speed. Constant torque motors should be specified for machine duty or any load where the horsepower varies directly with the speed. Constant horsepower motors should be specified when the horsepower does not change with the speed.

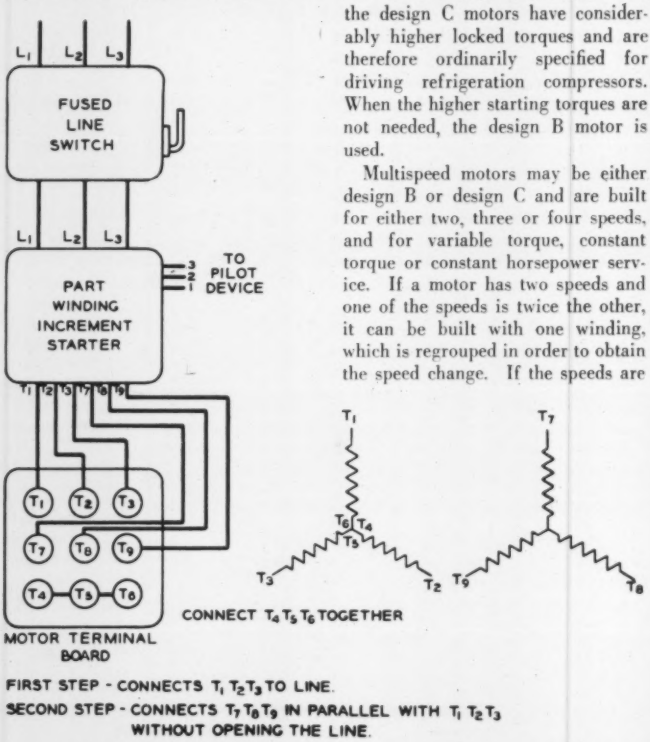


FIG. 8—CONNECTION DIAGRAM for a part winding increment type starter and a nine lead polyphase motor. This type of starter is pushbutton operated and can be pilot controlled

Compensator Starting of Squirrel Cage Motors

For many years compensators or auto-transformer starters were used for starting squirrel cage motors. A compensator consists of an auto-transformer provided with taps and a switch for connecting the auto-transformer to the line and to the motor. In the starting position, the auto-transformer is connected across the line and the motor terminals are connected to taps on the auto-transformer. Two or three taps are ordinarily provided so as to obtain several values of line starting currents. The application of reduced voltage to the motor results in a reduction in motor starting torque with a reduction in the line voltage. When the compensator is in its starting position, the motor starts and comes up to speed. The starter is then thrown into the running position, which disconnects the autotransformer and throws the motor across the line.

Part Winding Increment Starting

A later type of starter which has become very popular is the part winding, increment type starter which is used with motors having leads brought out from two or more groups of windings, such as nine lead, double voltage motors. When two groups of windings are used, the starter consists of two magnetic switches together with a pneumatic timer. When the starting pushbutton is operated, the first switch closes connecting the line to one group of

the motor windings and starts the pneumatic timer. After a suitable time interval has elapsed, the pneumatic timer closes the second magnetic switch connecting the other part of the motor winding to the line. With such a starter the current taken from the line is about 60 percent of the normal locked current of the motor while the locked torque developed by the motor is about 48 percent of its normal value.

This type of starter has the advantage that the current taken from the line is not broken during the starting period as is the case with the auto-transformer or compensator type, thus reducing voltage fluctuations and starter maintenance. The part winding increment type starter is pushbutton operated and can be pilot controlled, whereas the ordinary compensator is manually operated. (It is, of course, possible to obtain a pushbutton operated magnetic compensator but such a device is rather bulky and more expensive). Fig. 8 shows the external connections of a part winding increment type starter used with a double voltage motor, while Fig. 9 is an internal view of the starter.

When using either a compensator or an increment type starter, it is possible that the load may be sufficiently heavy so that the motor will not develop enough torque to start the load on the starting position. In that case, the motor simply stands still until full voltage is applied, at which time the motor starts. If the circuit which supplies the motor has automatic voltage regulation, the timing of the increment type starter may be adjusted so that the automatic voltage regulator will have an opportunity to bring the voltage back to normal before the second step of the increment starter has operated.

Mechanical Features of Motors

No attempt has been made to discuss the mechanical features of conventional type motors. However, they are available either with open, drip-proof, splashproof, or totally enclosed housings suitable for both horizontal and vertical mounting and the names of the various types suggest their application.

Motors of the hermetic type are also used extensively in the refrigeration industry and these motors are, of course, sealed in the same housing with the refrigeration compressor. They may be split phase or capacitor start in the small single phase ratings and polyphase squirrel cage in the large ratings. The single phase hermetic type motors do not have centrifugal switches but the starting windings are disconnected from the line by electrical relays mounted outside of the enclosure.

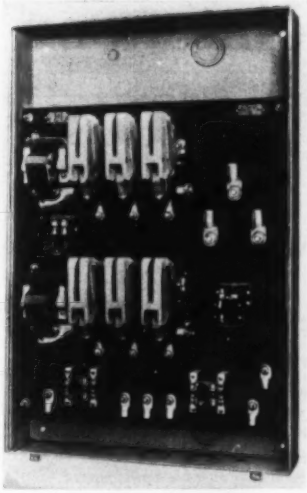


FIG. 9 — INCREMENT TYPE STARTER, connection diagram for which is shown in Fig. 8, is shown in this internal view. Such starters are used with motors having leads brought out from two or more windings

A complete discussion of all the features of single phase and polyphase motors would require much more space than is allotted to this article, but it is hoped that the more important items have been covered in a manner which will prove useful to those concerned with the proper application of motors.

SCIENTISTS PEER INTO THE FUTURE

A GROUP OF papers written on expected scientific developments by leading authorities in several fields of science and technology constitute a recent symposium, Science . . . and Tomorrow, in the Journal of the Franklin Institute. Commemorating its 125th year, this publication, published by the famed Philadelphia institute, is one of the oldest scientific journals in the United States.

Dr. Harold C. Urey, of the Institute for Nuclear Studies, University of Chicago, in describing advances in the field of chemistry, writes that "somewhere in the future, whether it is the remaining years of this century or years to follow, man will have an understanding of the origin of life . . . . ."

From Columbia University comes a statement by Dr. I. I. Rabi that extraordinary progress in experimental physics has been made since World War II. Dr. Rabi further states that discoveries which have been made have been of the utmost interest. "Still higher energy ranges, the billion electron volt region, will be available in a few years and in the next 10 or 20 years elementary particle phenomena will be well understood from the experimental point of view," Dr. Rabi says.

Television comes in for its share of prophecy from a scientific point of view. Dr. Oliver E. Buckley, President of the Bell Telephone Laboratories, in his paper on communications does not attempt to set limits that the art of television would not surpass. He does, however, mention some uses to which it may be put outside of the broadcast field, such as the observation of industrial processes at a distance, display of goods to customers at remote places and face-to-face conferences of dispersed individuals or groups.

Dr. Buckley ends by writing that "there is no reason to believe that the capacity of human brain power for uncovering new knowledge and applying it to useful ends is approaching a limit. The benefits to society will depend far more on the capabilities of humankind in general for making use of what is made available than on the capabilities of scientists and engineers for making new devices."

The use of radiant energy with the production of carbohydrates as a principal source of our heating fuels, foods and combustion engine fuels is expected by Dr. Wallace R. Brode, of the National Bureau of Standards.

In the field of solid state physics, Dr. Frederick Seitz, Research Professor at the University of Illinois, looks for "the straightforward examination of the principal imperfections in typical solids to provide a very stimulating and profitable field of research for at least a decade."

Practical Pointers on Estimating Job Costs

By Robert C. Soronen
Consulting Heating and Ventilating Engineer

Ability to estimate a job is not only important to the contractor but to the engineer and designer as well. Mr. Soronen explains here procedures he has used successfully, includes for reference a table of labor units he employs in preparing estimates

FIG. 1—HEATING tally or pricing sheet provides concise form for listing material, quantity, material unit cost, material cost extension, labor unit per unit of material, and labor extension

TITLE: Heating — DATE January 10, 1951
JOB OR BLDG. XYZ Mfg. Co. — LOCATION Wausau, Wis.
BID TO Architect — ADDRESS
ARCHT. OR ENG'R. John Jones, Architect — ADDRESS Wausau, Wis.
PLANS MARKED Heating & Ventilation — EST. NO. 1
EST. BY R.C.S. PRICED BY R.C.S. EXTENSION BY R.C.S. CHECKED BY — SHEET NO. 1

MATERIAL	QUANTITY	MATERIAL UNIT	MATERIAL EXTENSION	LABOR UNIT	LABOR EXTENSION
--"pipe, sch.#40, blk. stl. t&c.		-- -/c	0 000--	000	00-
--" " " " "		-- -/c	000--	0000	00-
--" " " " "		-- -/c	0 000--	000	00-
--" " " " "					
--"90 deg ells, 125# C.I., sc'd.	---	---	00--	000	00-
--" " " " "	---	---	00--	000	00-
-"x-"x-" tees, 125# C.I., sc'd.	--	---	00--	000	0-
--"unions, 150# M.I.,G.J., sc'd.	--	---	00--	0--	0-
--"pipe cap, 125# C.I., sc'd.	--	---	0-	--	0-
--"plug, sq. hd., solid iron	-	---	0-	--	0-
--"gate val., 150# brass, R.S. sc'd.	---	---	00--	--	0-
--"globe val., " " " sc'd.	--	---	00--	0--	0-
--"check val., 125#, swing, br., sc'd.	--	---	0-	--	0-
--"float & thermo. trap, 0-15#	--	---	00--	0--	0-
--"strainers, y-type, sc'd.	--	---	00--	--	0-
----edr condensate return unit	-	----	000--	00--	00-
----------	--	----	0 000--	00--	0-
----------	---	----	00--	0--	0-
----------	-	----	00--	0--	0-
Total-this sheet-material only			00 000--		
Total-this sheet-labor only					000--

THE ABILITY TO estimate closely the raw costs of materials and labor, and to prepare a firm bid selling price, is not only of prime importance to the contractor but to the engineer or designer as well.

Estimating requires mathematical accuracy, knowledge of equipment, records pertaining to current list and trade prices, cash discounts applicable to these prices, and above all, profound judgment and experience. The estimator must also have a record of wage hour rates for the areas in which the projects he is bidding are located.

In determining profits, two methods are commonly in use. The first is the "lump sum method", where a lump sum is added to the cost of material and labor. This amount will vary depending upon the contractor's circumstances, the customer, job location and knowledge of what competition is to be expected. This method does not permit exacting figures with respect to actual job profits. Due to existing economic conditions, where cost of materials and labor are shifting constantly, it seems better to make estimates on a unit basis for both material and labor.

A more correct means of determining profit is the "percentage method." On small contracts, the percentage will be greater than on large jobs where there is an increased volume of labor, material and duplication of equipment and installation procedures.

Location of the project or job in respect to the shop will affect not only the cost for total man and truck miles, and time, but it will also affect the transportation costs of materials from the suppliers.

Accurate detailed estimating involves a take-off of actual quantities, unit material prices, extension of the material prices, labor units, extension of the labor units, contingencies, allowance for freight and travel, drafting costs for working drawings, labor tax, insurance costs, and percentage for profit.

Complete plans (both mechanical and architectural), specifications, survey of job site, and in the case of alterations or revisions to existing buildings, a comprehensive survey of job conditions, are requisites of accurate and detailed estimating.

As an example, let us assume prep-

aration of a proposal or bid form for a year 'round heating and ventilation system.

If the contractor's facilities include the piping, sheet metal, electrical and plumbing trades, his only sub-bid will be for pipe and duct insulation, if required. If his only trades are heating and piping, then all of the trades foreign to his shop — such as sheet metal work, electrical and insulation — are turned out for sub-bids and the sub-contractor is then responsible for a complete take-off of material, labor and pricing.

In the latter case, the estimator will make a detailed take-off to include all pipe, fittings, valves, traps, pipe hangers and supports, strainers, boiler, oil burner or stoker, condensate return unit or vacuum pump, unit heaters, radiation, oil storage tank (in the case of an oil fired boiler), specialties, and all such other items which may be indicated on the plans or noted in the specifications, or otherwise required for the complete system.

The material take-off data should next be grouped and totalled on the "rough" sheets, and then transferred to a final tally or pricing sheet, similar to the sample sheet shown in Fig. 1, and bearing the title "Heating". The sample sheet illustrated provides a concise form for listing the material, quantity, material unit cost, material cost extension, labor unit per unit of material, and labor extension. The material and labor extension columns should be totalled at the bottom of the sheet — or sheets, if more than one is required — and the totals of this, or these, sheets are transferred to a "Heating Recap" sheet similar to the sample shown in Fig. 2. The totals appearing on the bottoms of the individual sheets represent only the raw costs of materials, and labor in hours.

If the contractor's business includes the sheet metal, electrical and insulation trades in addition to piping, sheets similar to the sample of Fig. 1 are prepared for the respective trades, together with the trade "Recap" sheets similar to Fig. 2. The totals on each "Recap" sheet of the individual trades are then listed on an "All Trades Recap" sheet similar to the sample in Fig. 3. If the contractor's business is limited to the piping field only, the "All Trades Recap" sheet will include his "Heating Recap" plus the bids of his various prospective sub-contractors.

To complete the "All Trades Recap", in addition to the totals for

TITLE: Heating Recap — DATE January 10, 1951
JOB OR BLDG. XYZ Mfg. Co. — LOCATION Wausau, Wis.
BID TO Architect — ADDRESS
ARCHT OR ENG'R. John Jones, Architect — ADDRESS Wausau, Wis.
PLANS MARKED Heating & Ventilation — EST. NO. 1
EST. BY R.C.S. PRICED BY R.C.S. EXTENSION BY R.C.S. CHECKED BY — SHEET NO.

MATERIAL	QUANTITY	MATERIAL UNIT	EXTENSION	LABOR UNIT	EXTENSION
Sub-total, material raw cost only, Sheet #1-heating			0,000.00		
Sub-total, labor raw cost only, in hours, Sheet #1-heating					00.00
Removal of existing work, lump sum			000.00		0.00
Sub-total, material & labor raw cost-heating only			0,000.00		00.00

FIG. 2—HEATING RECAP sheet is used for the totals taken from the various sheets such as shown in Fig. 1. Totals represent only the "raw" costs of materials, and labor in hours

TITLE: All Trades Recap — DATE January 10, 1951
JOB OR BLDG. XYZ Mfg. Co. — LOCATION Wausau, Wis.
BID TO Architect — ADDRESS
ARCHT OR ENG'R John Jones, Architect — ADDRESS Wausau, Wis.
PLANS MARKED Heating & Ventilation — EST. NO. 1
EST BY R.C.S. PRICED BY R.C.S. EXTENSION BY R.C.S. CHECKED BY — SHEET NO.

MATERIAL	QUANTITY	MATERIAL UNIT	EXTENSION	LABOR UNIT	EXTENSION
Heating-Raw Cost, M&L			00,000-		000-
Sheet Metal-sub-bid			0,000-		
Electrical (controls) sub-bid			000-		
Insulation-sub-bid			0,000-		
(sub-bids include labor)					
Sub-total: raw cost all trades			00,000-		000-
Miscellaneous & contingencies @ 0%			000-		00-
Material freight			00-		
Sub-total: Material & Labor			00,000-		000-
Total Labor: 000 hours @ $0.00 per hour			0,000-		
Supt: 00 hours @ $0.00 per hour			000-		
Labor tax: total labor X 0%			00-		
Travel: truck miles X 0¢ per mile			00-		
Travel: man miles X 0¢ per mile			00-		
Permits			00-		
Shop drawings			000-		
Total Cost: Material & Labor			00,000-		
Profit @ 00%			0,000-		
Total Selling Price			00,000-		

Fig. 3—ALL TRADES RECAP sheet shows the various totals taken from the various recap sheets such as illustrated in Fig. 2. The grand total on this sheet is the contract selling price

TABLE 1—LABOR UNITS, based on per foot of pipe or per unit item and expressed in hours, used by the author in preparing estimates

PIPE

Size	Threaded & Coupled	Plain End	Copper
⅜	0.18	0.12	0.08
½	0.18	0.12	0.08
⅝	—	—	0.08
¾	0.18	0.12	0.08
1	0.18	0.12	0.08
1-¼	0.18	0.12	0.08
1-½	0.18	0.12	0.08
2	0.18	0.12	0.08
2-½	0.18	0.12	0.10
3	0.20	0.12	0.10
3-½	0.20	0.13	0.10
4	0.20	0.17	0.10
5	0.20	0.23	—
6	0.20	0.30	—
8	0.30	0.43	—
10	0.40	0.47	—

ELBOWS—90 & 45 DEG. STRAIGHT & REDUCING

Size	Cast & Malleable Iron	Welding	Copper
⅜	0.06	—	0.12
½	0.06	—	0.13
⅝	0.06	—	0.14
¾	0.06	—	0.15
1	0.06	—	0.16
1-¼	0.06	—	0.17
1-½	0.08	—	0.18
2	0.08	0.60	0.20
2-½	0.12	0.60	0.22
3	0.14	0.75	0.24
3-½	0.14	1.10	0.26
4	0.16	1.75	0.30
5	0.16	2.00	—
6	0.18	2.50	—
8	0.20	3.00	—

TEES—STRAIGHT & REDUCING

Size	Cast & Malleable Iron	Welding	Copper
⅜	0.09	—	0.18
½	0.09	—	0.20
⅝	—	—	0.21
¾	0.09	—	0.23
1	0.09	—	0.24
1-¼	0.09	—	0.25
1-½	0.12	—	0.27
2	0.12	0.90	0.30
2-½	0.18	0.90	0.33
3	0.21	1.13	0.36
3-½	0.21	1.65	0.39
4	0.24	2.62	0.45
5	0.24	3.00	—
6	0.27	3.75	—
8	0.30	4.50	—

PIPE CAPS

Size	Cast & Malleable Iron	Welding	Copper
⅜	—	—	0.08
½	0.04	—	0.08
⅝	—	—	0.10
¾	0.04	—	0.10
1	0.04	—	0.11
1-¼	0.04	—	0.11
1-½	0.05	—	0.12
2	0.05	0.40	0.13
2-½	0.08	0.40	0.14
3	0.09	0.50	0.16
3-½	0.09	0.73	0.17
4	0.11	1.15	0.20
5	0.11	1.32	—
6	0.12	1.65	—
8	0.13	2.00	—

FLANGES—COMPANION, BLIND

Size	Cast Iron Sc'd.	Welding Neck & Lap Joint	Welding Slip-On
½	—	0.40	0.60
¾	—	0.40	0.60
1	0.04	0.40	0.60
1-¼	0.04	0.40	0.60
1-½	0.05	0.40	0.60
2	0.05	0.40	0.60
2-½	0.08	0.40	0.60
3	0.09	0.50	0.75
3-½	0.09	0.73	1.10
4	0.11	1.15	1.75
5	0.11	1.32	2.00
6	0.12	1.65	2.50
8	0.13	2.00	3.00

Notes:

1. Screwed couplings, and both screwed and welded reducers, and return bends, same as 90 and 45 deg elbows.
2. Copper to copper couplings, reducing couplings, and return bends, same as copper elbows.
3. Screwed malleable iron unions, and copper to copper unions, same as respective type and size tee fitting.
4. Lateral fittings or 'Y' bends, screwed, welded or copper, same as tees.
5. Screwed or copper to copper valves, to include gate, globe, check and cocks, same as tees.
6. All types of bushings and plugs, same as pipe caps.
7. For flanged joints using square head machine bolts with hex nuts, use 0.01 hr per bolt.
8. Flanged joints using stud bolts, use 0.02 hr per stud.
9. Gaskets estimated at 0.02 hr per unit connection.

the various trades, such items as percentage for miscellaneous and contingencies, freight, supervision, labor tax, truck and man mileage, permits, shop drawings and profit are included. The grand total appearing as the last item on the "All Trades Recap" represents the contract selling price.

Labor units for pipe, fittings and miscellaneous specialties which have been used by the author in preparing estimates are included in Table 1.

In cases where it is desired only to provide an approximate "round number" estimate for budgeting purposes, the reader is referred to the Heating, Ventilating, Air Conditioning Guide, published by the American Society Of Heating and Ventilating Engineers, and its chapter on owning and operating costs.

In preparation of the above text and accompanying data, the author makes no attempt to claim originality, except as to manner of presenting the data collected from various sources over a period of years, and the modifying, condensing and arranging of it for handy reference.

AIR CONDITIONING UNIT INSTALLED OUTDOORS

WHEN THE JUAREZ furniture store, Laredo, Texas decided to install air conditioning, it was faced with an unusually difficult problem of placing the equipment, according to the United States Air Conditioning Corp.

The one story, corner store building, with a half-balcony in the rear, has no basement or equipment room, and its roof is incapable of supporting either an air conditioning unit or a cooling tower. Furthermore, the owner opposed diversion of any valuable floor or balcony display space to air conditioning use. The store, however, had a rear porch, with a partial concrete floor, offering a solution to the problem by placement of the equipment outside.

The concrete slab was extended and reinforced to support a 15 ton packaged unit, which is completely enclosed and fitted for outdoor installation, and contains a built-in evaporative condenser. The unit was connected by ducts to grilles in the main store area and on the balcony.

The installation, carried out without interruption of normal store operation, was made by M. L. Garza.

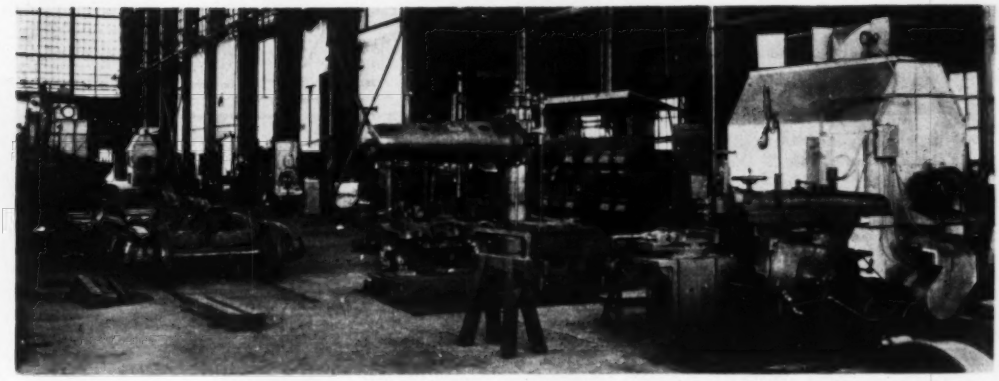


Fig. 1—UNIT SYSTEM of application of direct fired heaters. In this type of installation, each heater is a complete heating system in itself, without the use of ductwork

How To Use Direct Fired Units for Plant Heating

H. B. Schlosser, Chief Engineer, Lee Engineering Co., gives a number of examples showing the application of direct fired warm air heaters to industrial space heating. Units of this type may be floor mounted or suspended, may be placed horizontally or inverted to suit the job conditions. They may be used as units, or as central systems with ductwork. Practical comment is given on various arrangements, and typical applications are shown

DIRECT FIRED WARM AIR space heaters are being adapted to many types of application in an ever widening field. The reasons are simple and logical: The principle is sound; installation and maintenance costs are usually low; fuel efficiency is usually high; and such heaters lend themselves easily to a variety of installations and applications.

The Unit Method of Application

In the unit system of application, Fig. 1, one or more heaters are placed inside of the space to be heated. In this type of installation, each heater acts as a complete heating system within itself and without the use of ductwork. When floor mounted, the warm air is blown out at an elevation of 9 to 12 ft above the floor over a radius of 50 to 150 ft (depending on the size of unit and the angle of deflection). The cooler air is drawn into the base of the heater near the floor level at low velocity, thus forming a "heating circuit" at working level.

In the actual application of this system of heating, there are many factors to consider. To illustrate the point, Fig. 2, a plan view for heating an old building with wooden trusses which is used for steel fabricating, is shown. There was no room for floor mounted heaters in this building, and it was impossible to suspend the units because of the type of building construction.

A lean-to type of housing for each heater, constructed of steel framework covered with aluminum sheathing, was therefore decided upon. Short ducts attached to the outlets on top of the heater direct warm air to the small enclosed areas on both sides of the main building

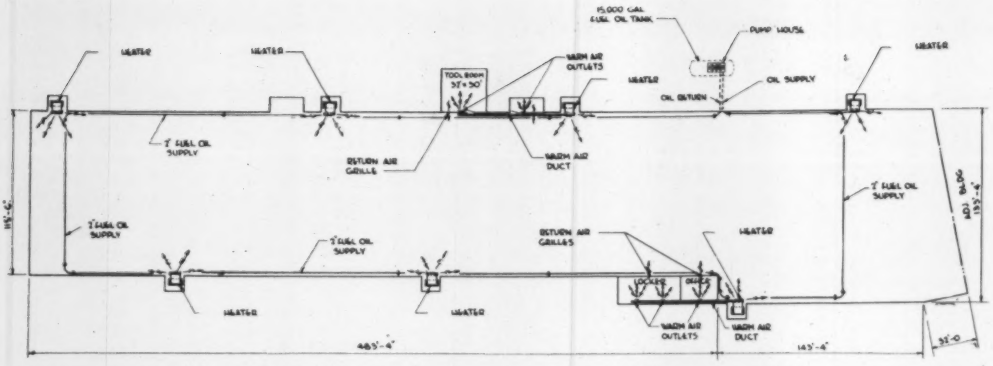


FIG. 2—LEAN-TO HOUSING for each heater was used at this building occupied by steel fabricating firm, as there was no room for floor mounted heaters and building construction prevented their being suspended

which are used as toolrooms, toilet room, locker room and shop office. No other ductwork is required. This is a practical method for supplying 10,500,000 Btu to heat an old and congested building.

Using Units for Central Systems

In a central system, the heater is placed in a central location, warm air being delivered by ducts to the heated space or spaces. In a new building it is often economical to install underground ducts during erection.

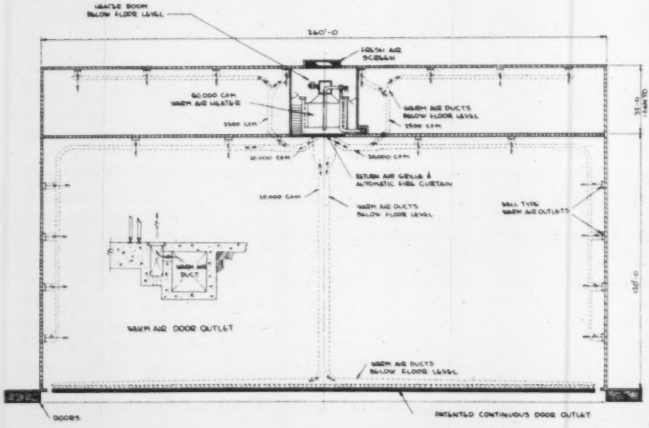
A plan view of a central warm air heating system for an airline hangar is shown in Fig. 3. Attached to the hangar is a one story lean-to used as office space. Warm air to all the heated space is supplied by underground ducts to wall registers.

The warm air curtain across the hangar doors serves to keep ice and snow melted so doors can be operated in all kinds of weather. The heater is located below floor level in a fireproof heater room. By use of automatic dampers, two speed heater fan, and modulating firing controls, a zone system of heating can be accomplished.

When adapting a standard direct fired heater to a central system — that is, installing it with discharge and return air ducts — it is quite important to check the static pressure of the proposed duct system. Direct fired heaters are usually built and delivered as a package, with fans and motors mounted. When greater fan capacity is required because of the duct system, this can be obtained by using the next size larger motor and increasing the fan speed. It is customary to obtain recommendations from the heater manufacturer before designing a central system around a heater. When properly designed, within its limitations, the direct fired heater serves economically and satisfactorily as a central heater.

In the application of direct fired heaters to theater, auditorium and school central heating and ventilating systems, a relatively large volume of air may be moved by a heavy duty, slow speed fan mounted independent of the heater. Because of the large volume of air handled, the heat rise through the heater is reduced and controlled by means of modulating firing equipment in a range of 10 F to 50 F. Filters, outdoor air intake and cooling coils may be incorporated into the system to provide ventilation and summer cooling. Several recent installations in a number of theaters have proved this method to be very satisfactory.

FIG. 3—CENTRAL APPLICATION of direct fired heater is illustrated in this plan view of an airline hangar. The warm air curtain across the doors keeps ice and snow melted to allow door operation



Providing Make-Up Air for Dust Collection

A unique application of direct fired warm air unit heaters is employed in a building used for grinding and buffing, where an extensive dust collection system is required. Approximately 90,000 cfm of dust laden air is removed through six collecting systems, and this created a negative pressure in the building, overloaded the heating system, and

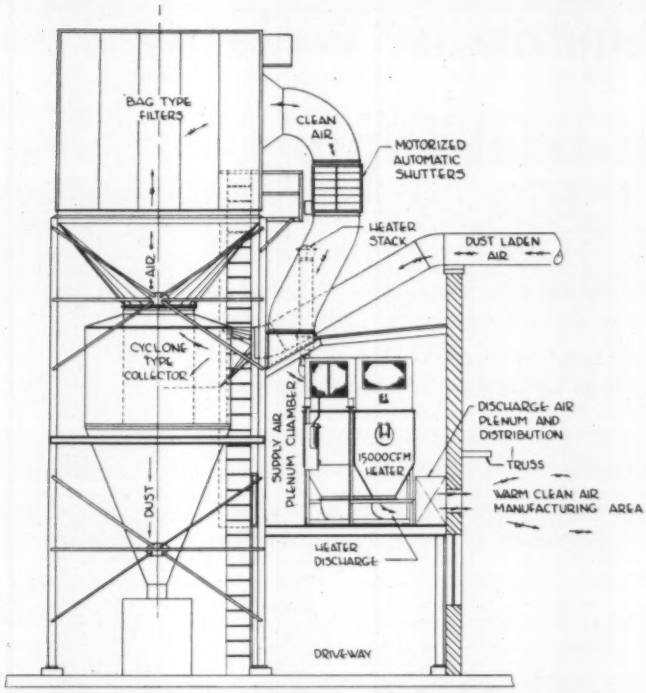


FIG. 4—DUST COLLECTION systems removed so much air at grinding and buffing plant that working conditions were bad. Six direct fired heaters, installed as shown in this end elevation, solved the problem

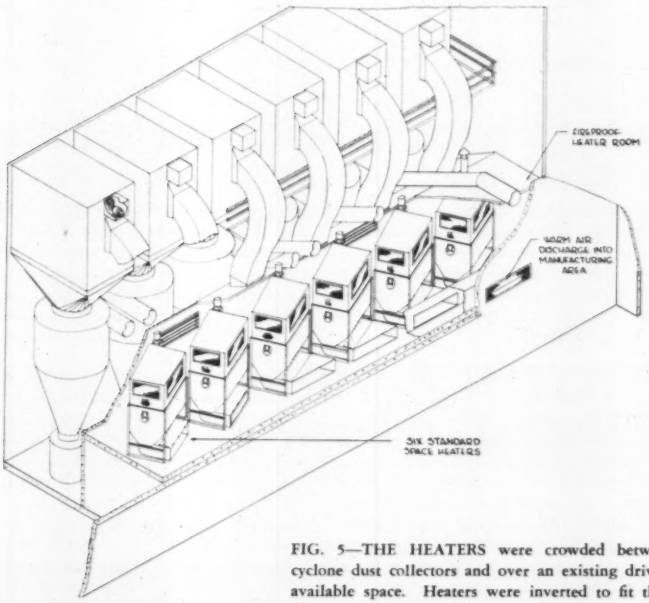


FIG. 5—THE HEATERS were crowded between the building and the cyclone dust collectors and over an existing driveway, as this was the only available space. Heaters were inverted to fit the job conditions

caused unsatisfactory working conditions due to drafts and inadequate temperatures.

To correct the condition, the dust laden air after passing through a cyclone type dust collector is carried to bag type filters and then returned to a new heater room in which is located six direct fired heaters. Each heater has capacity to deliver 15,000 cfm, the approximate capacity of each of the six dust collection systems, and supplies heat at the rate of 750,000 to 1,000,000 Btu per hr (depending on the firing rate) to the air stream.

Each heater is wired into the fan circuit of the respective collection system. Whether only one or all six systems are working, the same amount of dust laden air removed is replaced by clean warm air. The firing equipment is suitable for using either gas or oil for fuel and is thermostatically controlled. The end elevation arrangement is shown in Fig. 4, and a schematic view is shown in Fig. 5.

It will be noted that the heater room was crowded in between the building and the cyclone dust collectors, and suspended over an existing driveway — the only available space. In order to discharge the warm air into an unobstructed area, it was necessary to invert the heaters. The air from the bag type filters is piped into the heater room, which acts as a plenum chamber. Each heater discharges into another plenum which is sealed off from the heater room. This discharge plenum serves as a distributing duct to the warm air outlets through the adjacent wall into the area where the heat and air balancing is required.

Fire doors installed in the discharge plenum are held open by fusible links. In case of fire the links break, closing the doors. When the fire doors close they automatically trip a normally closed switch which breaks a relay circuit interlocked with the firing controls on each heater, thus shutting down all the heaters automatically and simultaneously.

Back draft dampers in the heater room walls insure sufficient air for combustion and supply air to the main heater fans.

Workmanship in Welding Industrial Piping

Control of shrinkage and distortion when welding industrial piping systems, repair of welds, preheating and stress relief, other thermal treatment, distortion in heat treating, straightening of pipe assemblies and cleaning and finishing are discussed in this authoritative review

PRECISE CALCULATIONS of shrinkage in welded pipe joints are impractical. In general, however, shrinkage values vary directly and principally with the thickness of the heaviest section being welded and the heat input and, inversely, with the degree of restraint imposed by fixtures, if used. The theoretical aspects of the subject of shrinkage and consequent distortion, the control therof, and of the stresses set up in welded joints due to the thermal action or mechanical restraint are treated at length in chapter 43 of the Welding Handbook.

Shrinkage and Distortion

For practical purposes in pipe welding, the angular distortion in circumferential and in intersecting welds can be controlled, and its extent reduced to a minimum by (1) proper application of the welding procedure, particularly with respect to uniformity of heating, (2) uniform preheating of the parts prior to and during the welding operation and (3) the use of fixtures for holding the parts in fixed relation to each other during welding. The first two of these methods contemplate free movement of the parts and generally result in lower residual stresses, while with the third method, the opposite is true. Residual stresses can be relieved to some extent by peening or by thermal treatment. Distortion can be corrected by the straightening operations hereinafter described.

In fabricating headers or other assemblies containing various types of welded joints in close proximity to one another, the control of distortion due to shrinkage is quite complicated and involves considerations of the layout and fitting of the assemblies, the sequence of welding, positioning of the welds, and the avoidance of heat concentrations, from the standpoint of not only their individual effect but also their relative effects on the entire assembly. The expedients employed to control such distortion have already been mentioned but their effectiveness is difficult to estimate, and depends on the welder's experience to a very great degree.

Repair of Welds in Piping

When a weld is to be repaired, the defect should first be removed by chipping, machining or by oxygen gouging or oxygen cutting, provided these processes are suitable for the metal. After removal of the defect, the surface upon which the repair weld is to be deposited should be so shaped and cleaned that a sound weld may be obtained. If preheating was required in making the original weld, it should be employed also in making the repair. Should there be general sweating of a weld, no attempt to repair it should be made. The entire weld should be removed and the joint rewelded.

Preheating and Stress Relief

Methods Employed — Preheating may be accomplished by any one of several methods. The simplest, of course, is torch heating. It is recommended, however, that this method be used only for pipe which is of sufficiently small diameter to result in a reasonable degree of temperature uniformity around the circumference and where the heat input due to welding is such that no supplementary heating is required to maintain the desired temperature. Where supplementary heating is required, as is usually the case, it is usually accomplished by electric heating elements wrapped around the pipe ends or by fuel fired, muffle type furnaces designed to fit around the ends, leaving an open space at the joint for welding. In the case of electric heating, the coils may be designed to heat by conduction and radiation or by induction. In the latter case, the heating current is usually switched off during actual welding, as the induced current in the pipe interferes with the welding.

The most satisfactory method of stress relief is by heating in a fur-

The chapter on industrial piping of the new third edition of the American Welding Society's Welding Handbook—from which this material has been taken by special permission—was prepared by a committee consisting of D. H. Corey, The Detroit Edison Co., chairman; A. N. Kugler, Air Reduction Sales Co.; J. D. Mattimore, Tube Turns, Inc.; J. Hall Taylor, Taylor Forge & Pipe Works; H. Weisberg, Public Service Electric and Gas Co.; and C. C. Zimmerman, Benjamin F. Shaw Co.

nace, and this is done whenever practical. However, this method is, in general, suitable only for shop welded subassemblies. Methods which have been used in the field for circumferential butt welds are electric heating by induction with low frequency electric current (60 cycles or less), electric heating by conduction and radiation with coiled heating elements wrapped around the joint and flame heating with metal or refractory furnaces of the muffle type designed to fit around the joint.

Temperature Control—The control of temperature in both preheating and stress relief operations is especially important and frequently influences selection of the equipment. If torch heating or muffle type gas fired furnaces are used, control of temperature is generally accomplished by manual regulation of the heating apparatus, and the temperatures are checked by the use of portable pyrometers, or pyrometric cones. If electric heaters are used, control of temperature is accomplished by electrically operated pyrometers that automatically control the current flow to the heating units, and indicate the temperatures throughout the entire heating cycle. There are also available, with some types of electric heating equipment, electrically operated program control devices that can be set to automatically control the time-temperature cycle of a stress relieving operation within any desired limits of apparatus capacity.

In preheating or stress relieving welds in any of the alloys that have air hardening tendencies, special precautions should be taken to exclude as much as possible the circulation of air around the joint, both during heating and cooling periods. This can be done by positioning the work in a part of the shop where there is little draft and by closing up open ends of the parts being welded to prevent air circulation through the interior of the piping during the heating period. During the cooling cycle the joint should be covered with a suitable insulating jacket immediately after the welding is completed.

Other Thermal Treatment

It is frequently necessary to totally heat treat complete welded piping assemblies not only for stress relief but also to restore the original structure of the metal or to attain other desirable properties. This may involve annealing, normalizing or quenching treatments, depending on the alloy welded, and requires extensive furnace equipment for its application. Such furnaces are usually gas or oil fired, pyrometrically controlled and of such construction and proportion as to allow the treatment of a number of assemblies in one charge.

It is beyond the scope here to describe in detail these various heat treating procedures as applied to the various metals used in piping, except to state that the work requires the supervision of a competent metallurgist, and rather extensive laboratory equipment for analysis of results.

Distortion in Heat Treating

The temperatures employed in stress relief and other heat treatment operations are often in a range where the properties of the metals to resist deformation are lowered to an appreciable extent. It is therefore necessary to properly support the welded joint during the stress relieving operation in a manner that will reduce to a minimum the possibility of deflection in any direction. This can be readily accomplished in the shop by placing adjustable roller type supports under the parts being welded as near to the joint as possible, allowing sufficient space for the placement of the heating apparatus over the joint. In field work, where the welds are made in position, chain falls or other suitable rigging secured to the building or other supporting structures can be used to accomplish the same purpose.

If stress relief or heat treatment of a number of assemblies is done in a heat treating furnace, special care should be exercised in placing the assemblies to make sure that they are adequately and uniformly supported in all directions, using temporary structural bracing tack welded to the assemblies, if necessary.

Straightening of Pipe Assemblies

The welding of piping assemblies, due to the expansion and contraction of the metal, distorts the original setup and alignment of parts to a varied extent, depending upon the metal welded, its size, shape and thickness. Much of the distortion can be controlled during welding, some of it corrected during stress relieving, when used, but in most cases it is found necessary to correct the effect of distortion independently.

One method employed to correct misalignment is the controlled alternate heating and cooling of areas adjacent to the weld so that the consequent expansion and contraction of the metal will tend to draw the parts into proper alignment. The application of this method is limited to those materials upon which the effect of the alternate heating and cooling is not particularly detrimental to the properties or structure of the metal.

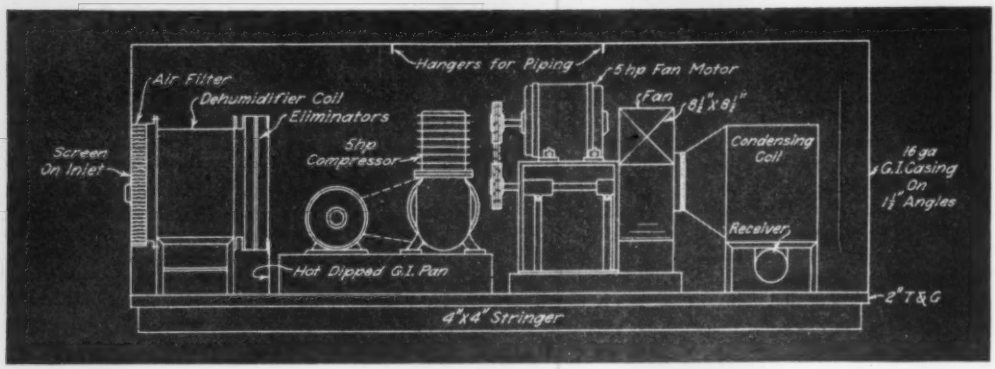
To illustrate the elements of this method, assume that a length of reasonably straight pipe is clamped firmly at one end to a rigid table. If an area for a length of 6 in. or more is heated around the pipe adjacent to the clamping device to a red heat and then a stream of cold water suddenly applied to one side of the pipe, the sudden contraction will cause the free end of the pipe to deflect in the direction of the side of the pipe thus cooled.

It is readily seen that the application of heat and of the cooling medium requires considerable skill and judgment, if satisfactory results are to be obtained. Such skill is only acquired through experience since there is no method that has as yet been devised by which the deflection resulting from such heating and cooling can be precisely calculated.

Another way of correcting misalignment, which has wide application to assemblies that have been furnace annealed or normalized, is to set up the assembly in a facing head with the normal axis of the piece in line with the center lines of the machine, and then machine the flanges or ends so that their faces are square with the normal axis of the pipe and with each other, and meet the overall dimensional requirements of the piece.

The foregoing methods of squaring and aligning are of course applicable in cases where the assemblies after welding are distorted to a considerable extent. Another method of correcting misalignment is by the gradual application of force, commonly known as *cold pulling*. This method has limited application, however, due to the possibility of setting up excessive stress concentrations in an assembly, and should be employed only in cases where the effect of such

[*Concluded on page 99*]



WARM, DRY AIR for the underground conduits carrying electrical power cables, to protect the cable sheathing against corrosion due to moisture condensed from outdoor air, is provided by this heat pump and air circulating equipment

Heat Pump Protects Underground Electric Cables Against Corrosion

By Arthur J. Hess
Hess, Greiner & Polland, Inc.

Replacement of underground electric cables became an important item of maintenance expense after but a year of operation at an automobile plant. The trouble was caused by deterioration of the cable sheathing due to moisture condensed from outdoor air pulled into the relatively cool cableways. The problem has been solved by a 5 hp heat pump to provide warm, dry air forced into the cableway system

A HEAT PUMP and dehumidifying unit was used to solve a troublesome and expensive problem at the Chevrolet plant of General Motors in Southern California.

The problem existed in the underground electrical power distribution system of the plant as a result of disintegration of the sheathing of the electrical cables due to corrosive action of water distilled from relatively high dew point air coming into contact with the walls of the cableway, which are at the same low temperature as the ground. The power distribution system consists of lead sheathed cables pulled through multi-cell glazed tile sectional conduits buried in the ground under the building and running from a power inlet manhole to a number of key distribution manholes throughout the plant. From each manhole steel power conduits fan out to load centers located about 15 ft above the floor on the building columns, from which point the power is distributed overhead to various machines and equipment.

The basic reason for the difficulty with corrosion of the cable sheaths was the circulation of outside air through the conduit system, such circulation being set up by the chimney effect of the conduits terminating in the load centers located at relatively high points on the columns. This chimney effect pulled in outside air through holes and other openings in the manhole covers. At certain times of the year, relatively high dew point air was pulled into the system and cooled below the dew point by the cool conduit surfaces. The result was a considerable volume of condensate that corroded the cable sheathing. After but a year of operation cable replacements began to

be a noticeable maintenance item and when this item reached several thousand dollars per month the owner decided to do something about it.

1300 Cfm at 7 In. Pressure

Studies of the problem indicated the most practical solution to be that of maintaining the system under an artificial pressure produced by supplying warm, dry air in sufficient quantity and at a pressure to insure that all openings would exfiltrate air. A high pressure fan produces an air flow of 1300 cfm at a pressure of 7 in. water gage and a 5 hp heat pump dries the air by cooling entering air through an evaporator coil to a low dew point and reheating this air through the condenser coil. The unit designed to accomplish this is shown in the accompanying drawing.

The system has been in operation for over a year, and since its installation no conduits have been replaced and all manholes have been dry and easy to work in.

The installation was made by the F. B. Gardner Co., Los Angeles.

WELDING PIPING—

[Concluded from page 97]

stress concentrations would be negligible.

The final step in the straightening operation is the checking of all parts and dimensions of the assembly with the requirements of the drawing from which the assembly was constructed. While this procedure is essentially a function of inspection, much additional handling can be avoided if the work is done before the assembly is removed from the straightening table. This is especially the case on work that is subject to inspection by an outside agency, and is being produced in sufficient volume to require a full-time inspection service.

Cleaning and Finishing

Cleaning of welded piping is of considerable importance. The extent of cleaning and the methods used are of course dependent upon the type of work involved, and may range from merely blowing out piping by compressed air or steam to pickling and passivating.

For carbon steel piping where no backing rings are used, care should be taken in the welding procedure to avoid excessive formation of icicles or other projections of the weld metal into the interior of the pipe. Where it is possible such icicles should be removed with a chipping hammer or grinding wheel as the piece is being built, especially so if the roots of the welds become inaccessible after the various connecting parts are assembled.

Flange faces or machined, beveled ends, if adjacent to a weld and likely to be spattered during welding, should be coated with one of the several solutions available on the market for protecting such surfaces against the pelting effects of the spatter, and facilitating its removal.

Unless piping is heavily scaled as a result of heat treating or other causes, it can be adequately cleaned inside with turbine cleaners which function in much the same manner as boiler tube cleaners. If such equipment is not available, rapping the outside of the piping and blowing it out with air or steam will suffice, although this method takes considerable time and additional handling and is not always reliable.

If the piping has been heavily scaled, it should be sand or shot blasted outside and inside. If sand blasting of the inside is not feasible, turbining may be employed to advantage in some cases provided that special care is taken to make sure that the turbine heads are cutting to the base metal.

The cleaning methods usually employed on alloy steel piping are similar to those used for carbon steel piping. Frequently, however, the service for which alloy piping is used requires absolute cleanliness of the piping and the removal of all traces of scale or other foreign matter. In such cases, perhaps the only positive way of assuring cleanliness is by pickling the completed assemblies, either by immersion in pickling vats or by adaquate swabbing of the piping with pickling solutions, followed in either case by passivating and then washing with water, depending on the requirements for the particular metal.

The solutions used for pickling or passivating vary with the metals treated, and the methods employed are dependent on available facilities and the practices of the manufacturer. Reference should be made to standard texts on the subject.

Finishing of welded piping entails thorough inspection, the methods of which are treated in the Welding Handbook. In applying these methods, insofar as they affect workmanship, the following comments are of importance.

Except for in-process inspection of welding, most shops arrange for inspection and testing of the completed assembly to follow all other fabricating operations and provide their facilities accordingly.

Non-destructive testing by radiography or magnetic powder methods usually follows postheat treatment operations if such are involved, and is done under controlled laboratory conditions. While some of the larger shops are fully equipped for X- ray examination, its application to pipe work is somewhat limited and it is believed that gamma ray examination is to be preferred due to the fact that it has more flexible application to piping, especially so in connection with field welded joints.

Generally speaking, hydrostatic tests, as prescribed by codes and specifications, are applied to assemblies that are fitted with flanged or screwed ends regardless of the ultimate service pressure. If, however, the ends of the assemblies are prepared for field welding, they may be fitted with suitable gaskets and friction clamps that will permit hydrostatic testing up to 60 psi. Tests of this latter sort, however, are only advisable for work subject to low service pressure.

Where the service pressure is severe and full hydrostatic testing on assemblies fitted with welding ends is mandatory, it is necessary to weld temporary heads or caps on the connecting ends of the assemblies so that the required test pressure can be safely applied. In such cases the welding ends of the assemblies are not finished to dimensions until after the testing has been completed.

Air testing is employed to a limited extent in general fabricating practice and usually only to satisfy the requirements of a particular specification. The larger fabricating shops necessarily have facilities for supplying compressed air for other plant services and can therefore usually arrange to test with compressed air up to 100 psi.

How Macy's-Kansas City Was Completely Air Conditioned

By William L. Cassell
Consulting Engineer

Macy's in Kansas City is an outstanding example of a completely air conditioned modern department store. Comprising a new seven story building and a completely renovated six story existing structure, part of which was erected in 1904 and part in 1914, it is cooled by three centrifugal compressors totalling 1335 tons of refrigeration. Windowless construction results in worthwhile initial and operating cost savings.

MACY'S, IN KANSAS CITY, is an outstanding example of a modern department store which is entirely air conditioned. The project consisted of the construction of a new seven story building and the complete renovation of the adjacent six story building, which consisted of one structure erected in 1904 and another erected in 1914. The work was completed October 1949.

The 1914 structure was erected on a fireproof steel frame designed to support five additional floors for a total of 11 stories, the ultimate scheme anticipating a building of this height. The total cube of the building is 6,300,000 cu ft, with 437,300 sq ft of floor area (including outside walls.)

In order to hold expenditures to a minimum and to maintain mechanical and electrical services for the existing building, wherever possible all mechanical and electrical risers, air conditioning units, toilet rooms, etc., were located outside of the existing building.

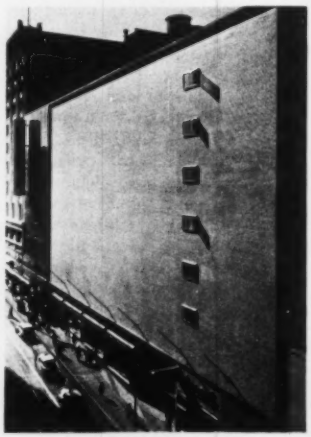
A vacated alley, in which were buried steam, power, light and street railway underground cables, ran through the center of the site of the new building. These utilities were suspended over the excavation for the sub-basement and maintained in service until a concrete duct, in the form of a beam across the machinery space in the sub-basement, was constructed and the utility lines relocated.

During the course of the entire building operation, it was mandatory that all normal department store activities in the existing building be maintained.

The existing building was supplied with d-c power and low pressure steam from the street main. The new installation required the installation of a-c power supply throughout. Steam for the new building is obtained from the street main at 1 to 5 psi pressure.

Since the new and remodeled portions are without windows, it was necessary to ventilate and air condition the entire building. The periphery stock arrangement used makes windows undesirable, with the exception of one small one for each floor on each facade to meet fire department access requirements. The absence of windows eliminates dust, dirt and air leakage, as well as the soiling and fading of merchandise stored near the exterior walls.

WINDOWLESS CONSTRUCTION reduces the air conditioning load by 90 tons, the resulting initial saving in building cost being over $60,000 and in annual operating cost some $2500



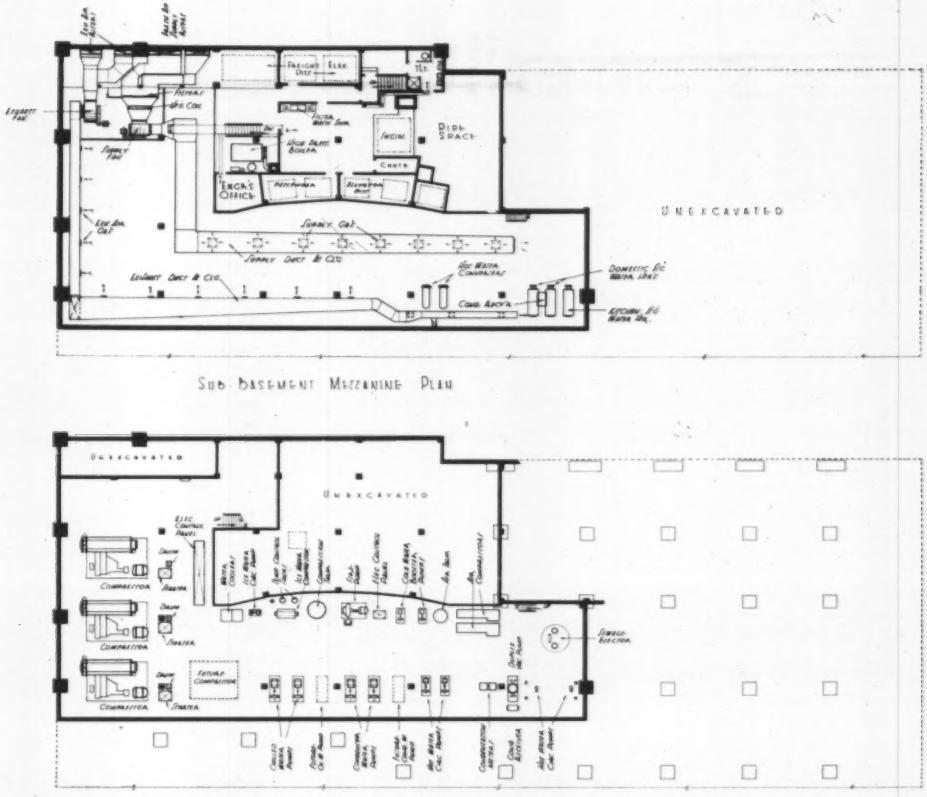
Windowless Construction Cuts Conditioning Load

As a result of the windowless construction, the air conditioning load is reduced 90 tons, and the equivalent direct radiation load 3400 sq ft. The resulting initial saving in building cost was over $60,000 with an annual operating saving of some $2500.

The sub-basement machinery rooms and the kitchen for the tea room are provided with supply and exhaust ventilation. The balance of the building is equipped with a summer-winter air conditioning system.

Refrigeration is furnished by three 400 hp electrically driven centrifugal compressors situated in the sub-basement. Each has a capacity of 445 tons based on cooling 1110 gpm of water from 53.65 F to 44 F, or a total capacity of 1335 tons. The design was based on an outside condition of 78 F wet bulb and 100 F dry bulb and an inside condition of 80 F dry bulb and 50 percent relative humidity. Space is provided for additional refrigeration equipment when future additions are made.

Condenser water is cooled with a two cell, counterflow, induced draft cooling tower built of redwood with



SUB-BASEMENT MEZZANINE PLAN

THREE 400 HP CENTRIFUGAL compressors—with space for additional future refrigeration equipment—furnish chilled water which is circulated through two main risers to the various floors

an asbestos cement board outer casing, located on the roof. The tower has a capacity of 4005 gpm, 94.7 F to 85 F with a 78 F wet bulb.

Chilled water is circulated through the water coolers and then through two main risers to the various built-up fan and coil units or factory-built air units situated on each floor.

Two Fan and Coil Units On Each Floor

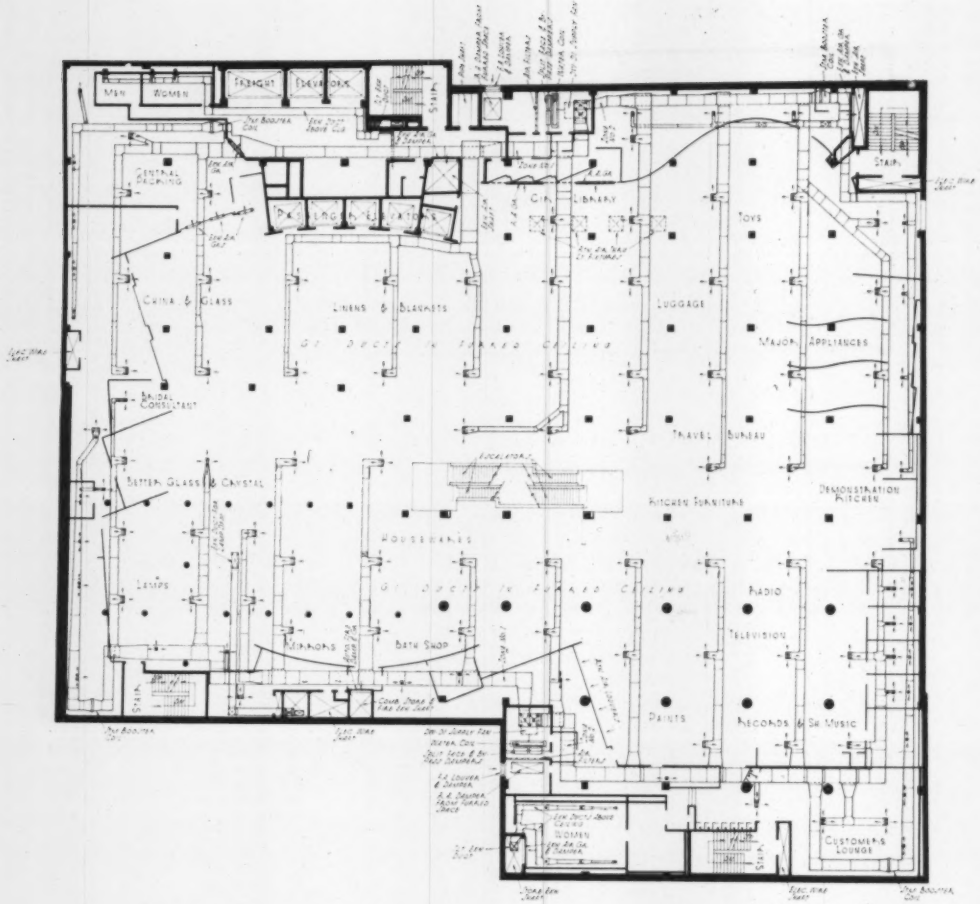
Each main floor is equipped with two built-up, pull-through fan and coil air conditioning units. Each consists of one double width, double inlet fan with adjustable inlet vanes on the fan inlets; a bank of six row copper cooling coils set on steel supports with insulated drip pans; two sets of face and bypass dampers for zone control purposes; a bank of high velocity 2 in. thick washable air filters; outdoor air and return air dampers; and an insulated steel fan housing.

Each air supply unit supplies one-half of each floor through galvanized ducts run above the suspended ceilings. Air is supplied to the air conditioned spaces through rectangular ceiling outlets. In large open areas, one air outlet per bay is provided; in smaller areas, the outlets are spaced to meet the requirements of the space served. The air supply on typical floors averages 1.2 cfm of air per sq ft of space served. The inlet vanes on the fan inlets are used to reduce the amount of air circulated in cold weather.

Air is returned through the suspended ceiling to the air mixing chamber adjacent to the air unit or is exhausted to the outside through the exhaust system, as desired.

Since typical floor areas are relatively large (over 45,000 sq ft per floor), it is desirable to have at least four separate zones of control on each floor. The population varies widely during sales at different points on the same floor. The zoning was accomplished effectively and at minimum cost by the use of a double width, double inlet fan; split face and bypass dampers; and splitting the discharge duct at the fan discharge. Little mixing in the air temperature between zones occurs in the air passing through the double inlet fan. It has been found that with a normal load the air temperature leaving the fan is approximately the same for each zone. Under extreme load conditions, the air leaving temperature required to maintain constant temperature on the same floor may vary 5 F between zones from the same fan.

Factory-built air supply units



EACH MAIN FLOOR is equipped with two built-up air conditioning units supplying one-half of the floor through ducts run above the suspended ceiling. Air supply averages 1.2 cfm per sq ft of space

were installed to supply smaller areas, such as the beauty shop, lunch room, alteration department and the executive offices.

The lighting load in the store was figured at 5 watts per sq ft of floor area. This load — plus the occupancy load — necessitates that all air supplied to the store be exhausted in mild weather. A large percentage of the air supplied in extreme weather is exhausted so that the refrigeration equipment need not operate when the outside temperature is below 60 F.

Air is exhausted from each floor through four exhaust air shafts situated around the outside walls. Each shaft is connected to a fan equipped with inlet vanes, the inlet vanes being remotely controlled from the engineer's office. The four fans, together with the toilet and other exhaust systems, are capable of exhausting 100 percent of the outside air supply when required.

Fire Exhaust Fan System for Escalators

The store is equipped with escalators from the basement to the fifth floor. Since — in order to meet city code requirements — the escalators could not be enclosed, it was necessary to install a special outdoor air supply and exhaust system. This system operates automatically in case of a fire on any of the floors served by the escalators and will cut off all other ventilating fans throughout the building.

One of the above-mentioned main exhaust fan and shaft systems located adjacent to the escalators was selected to be used as the fire exhaust fan system. This fan and shaft are equipped with pneumatic automatic temperature control devices to take over operation of the entire air conditioning and ventilating systems in case of a fire.

Automatically controlled fire dampers are located in the fire exhaust shaft adjacent to the escalator shaft on each floor. An outdoor air supply shaft equipped with automatic dampers extends from the fifth floor to the roof. In case of fire, a pneumatic temperature actuated device situated at the ceiling on each floor adjacent to the escalator shaft will actuate the automatic equipment. When a predetermined temperature

is reached, this device will turn in the fire alarm, stop all other fans in the building, start the fire exhaust fan, close all exhaust dampers in the fire exhaust shaft except the damper on the floor where the fire is located, and open the outdoor air damper at the top of the escalator shaft. The fire exhaust fan has capacity to exhaust air from any one floor in a quantity sufficient to produce a downdraft in the escalator shaft of over 300 fpm, as required by the city.

Tests made by various fire prevention agencies indicate that if a downdraft of over 300 fpm is created in a shaft during a fire on a lower floor of a building, the loss of life on an upper floor caused by overheated or toxic air rising in the shaft is reduced to a minimum.

Master Control Switch in Engineer's Office

The pneumatic temperature control system has a master control switch situated in the engineer's office which has three positions — winter, intermediate and summer. The winter and summer positions are normal. The intermediate position transfers control of the outdoor air and return air dampers directly to room thermostats. The intermediate position is for use with outside temperatures between 40 and 60 F, and has proved very effective in maintaining proper room temperature without the use of steam or refrigeration during intermediate seasons.

Show windows are equipped with separate exhaust systems in order to maintain proper temperatures, since each window has over a 10 kw lighting load. Show window exhaust fans are automatically controlled by thermostats.

The entire store has a flexible ceiling consisting of a grid system composed of standard ¾ in. and 1½ in. furring channels which carry the acoustical tile. The channels form a grid 2 ft by 4 ft on which are clipped the 1 ft by 2 ft tile panels. The air outlets and lighting fixtures fit into the grid openings and provide a basic design for installation of air outlets and lighting fixtures throughout the entire store. If, in the future, additional air outlets or lights are required or if changes in the fixture layouts are made, the air distribution and lighting can be handled at minimum cost.

AIR OUTLETS AND LIGHTING fixtures fit into the ceiling grid openings. If additional outlets or lights are required, or if there are changes in the fixture layouts, they can be handled at minimum cost

Heating and Ventilating the Store

Heating and ventilating are accomplished by the use of the same coils, piping, fan and duct system as used for air conditioning. Hot water is obtained from steam converters in the sub-basement and circulated with hot water pumps with a capacity of approximately one-fourth the chilled water pumps. The water coolers are arranged with valves so they can be cut out of the circuit when heating is required.

Steam booster coils are provided in air ducts supplying spaces adjacent to the outside walls and are controlled with thermostats on automatic control valves.

Each main entrance is supplied with heat from a separate air supply unit with a steam coil. The air is introduced through side walls near the floor and blown across the door opening. Air is returned to the air unit through return grilles adjacent to the entrances served. Each revolving door is supplied with warm air through a ceiling outlet on the inlet side of the door. Air units are equipped with washable 2 in. thick air filters. The coils and fan motors are automatically controlled from thermostats situated near the entrance doors.

A two pipe, low pressure, vacuum steam system supplies steam to miscellaneous radiators situated in stairways and private offices with large glass areas, to unit heaters over dock areas, entrance unit heaters and booster coils in air ducts. The condensate from the heating system is run through an economizer before being discharged to the condensate meter. The economizer unit is connected to the city water supply serving the domestic water heaters.

High pressure (80 psi) steam is obtained from a gas fired scotch marine 30 hp boiler in the sub-basement. Steam from this boiler supplies the kitchen and the steam presses in the alteration department.

Domestic hot water is supplied from three low pressure steam storage type water heaters situated in the sub-basement. One heater supplies the kitchen with 180 F water; one supplies 135 F domestic hot water for the building; and one is a standby piped to serve either water system.

Power is obtained from the power company's network 120/208 volt, three phase system supplied through four 3000 amp entrance busses. Two power entrances are provided for each side of the building. All fans are controlled from the remote pilot light control board located in the sub-basement adjacent to the engineer's office.

The corporate engineer for Macy's was J. Buckley Bryan, New York; the architects were Kivett & Myers; and the author was the mechanical engineer. The heating and air conditioning contractor was the U. S. Engineering Co., and the Gieske Sheet Metal Co. was the sheet metal contractor.

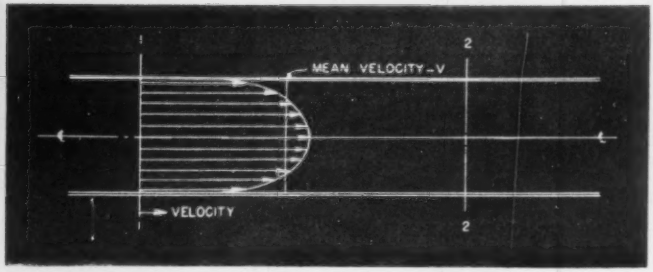


FIG. 1—For flow of air in this (or any) duct, a pressure difference must be maintained between cross sections "1" and "2"

Facts on Flow in Ducts

Although there are various well-recognized methods of designing ducts which are used in everyday work, it's important to have a speaking acquaintance with some of the fundamentals of fluid flow, says William Huebner, of the Anemostat Corp. of America

PROPER DESIGN of duct work is a most important ventilating and air conditioning problem. A decisive factor is a satisfactory estimate of the flow resistance of the system.

There are several recognized methods of designing ducts and it is not difficult to apply one of them. The practiced designer usually relies more upon his experience with these methods than upon the basic theory of air flow. It is important, however, to have at least a speaking acquaintance with the fundamentals of fluid flow.

Let us first consider the flow of air in a straight duct of constant cross section, as shown in Fig. 1. In order to cause a steady flow of air in the duct, a certain pressure difference must be maintained between the reference cross section "1" and "2". This pressure difference is necessary to overcome the frictional losses in the duct between sections "1" and "2". These frictional losses are produced partly by the viscous forces or skin friction and partly by the dissipation of energy in turbulence and eddies.

Research has shown the fluid flow in a duct is viscous, streamline or laminar as long as the velocity is low. In this case, the particles follow predictable paths free from eddies or swirls. With high velocities, the streamline character of the flow changes. Eddies form and the paths of the fluid filaments are sinuous and swirling. This type of flow is called turbulent. For medium velocities, the flow may be either laminar or turbulent. It should be kept in mind that the turbulence discussed here is microscopic and that it exists independent of the design or workmanship of the duct. If a certain critical velocity is reached, the flow becomes turbulent, whatever the material of the duct or degree of smoothness.

A demonstration model is sketched in Fig. 2. A glass tube with a rounded inlet leads from a large tank and terminates in a valve which controls the rate of flow. At the inlet is a small jet permitting the introduction of a fine stream of dye. The tank is filled with water and allowed to stand for several hours. Then the valve is opened slightly, which causes a colored filament of dye to extend the full length of the tube so steadily that it scarcely seems to be in motion. At higher velocities the filament begins to waver until a speed is reached at which eddies begin to form at the outlet end. Finally, the dye rapidly diffuses over entire area of the tube.

The velocity at which the eddies form is called the *upper critical velocity*. It has been found that this velocity is rather indeterminate. The velocity at which eddies cease when the velocity of turbulent flow is reduced slowly is called the *lower critical velocity*. This velocity is usually taken as the true critical velocity.

The pressure loss in a straight duct of circular cross section is commonly expressed by the formula

$$h = f\ (L/D)\,(V^2/2g)$$

where h is head loss due to friction, ft of the fluid flowing; L is the duct length; ft; D is duct diameter, ft; V is fluid velocity, ft per sec; g is acceleration due to gravity; f is friction factor, dimensionless. For standard air, the formula above changes to

$$h = f\ (L/D)\,(V/4005)^2$$

The friction factor f is a function of two dimensionless groups, the Reynolds number (R) and the relative roughness of the duct. For very low Reynolds numbers—below 2000

—the flow is viscous and f depends only on R. For high Reynolds numbers, f becomes independent of R and depends only on relative roughness. For the flow of air in air conditioning work, the value of the Reynolds number is commonly between $(10)^4$ and $(10)^6$ and the flow is almost always in the intermediate transition region between laminar and completely turbulent flow.

The Reynolds number is of the utmost importance as common basis for comparison of flow data. Experimental friction factors (f) have been plotted against values of R and these f-R charts have been used to compute air friction charts which simplify the problem of estimating the resistance in straight and round ducts.

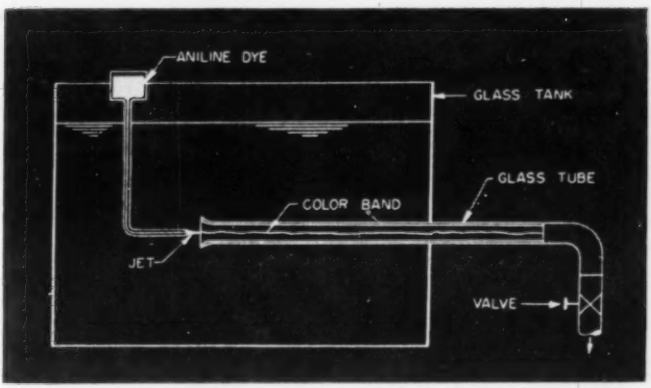


FIG. 2—In this demonstration model, the color band begins to waver at higher velocities, eddies next form at the outlet, and finally the dye diffuses over the entire tube area

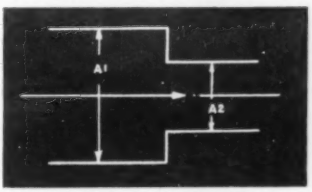


FIG. 3—Abrupt contraction of a duct causes a drop in static head due to an increase in velocity head and to resulting turbulence

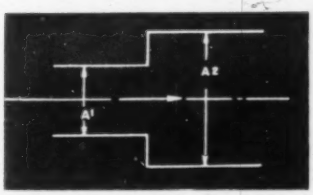


FIG. 4—Abrupt enlargement of a duct causes a loss in head due to the impact of the fast moving air against the slow moving air

Estimating the Friction Loss

Friction loss in straight round ducts can be easily estimated by using such charts. The friction factors for rectangular ducts may vary greatly from those of round ducts. A shallow rectangular duct offers more resistance to the air than does a square or round duct when each has the same cross sectional area. In general, the largest area for the least perimeter of duct gives the least frictional drop. Different cross sections can be compared with the help of the hydraulic radius, which is the cross sectional area divided by the perimeter.

The hydraulic radius of a rectangular duct with the sides a and b (in ft) is

$$m = (ab)/2(a + b)$$

The equivalent diameter of a circular duct with the same friction loss, when the velocity in the two ducts is the same, is

$$m = \text{area/perimeter}$$
$$= (\pi D^2/4) \div \pi D = D/4$$
$$D = 4m = 2ab/(a + b)$$

In air conditioning work, it is necessary to compare the diameter of a circular duct with the same friction loss as a rectangular duct, *when the volume flow rate is the same in both ducts.* The diameter of the duct can be found by equating the fundamental expressions for loss in the two types of duct. Using suitable friction factors, this formula was developed and is used by the American Society of Heating and Ventilating Engineers

$$D = 1.30 \sqrt[8]{\frac{(ab)^5}{(a+b)^2}}$$

Based on this equation, which is awkward to solve, suitable tables have been developed from which sizes of rectangular ducts equivalent to round ducts can be found.

The preceding discussion has been developed entirely around the frictional loss caused by straight duct runs. Losses through fittings, bends, elbows and transformations must in general be obtained from experimental data and are usually stated as equivalent in loss to a certain length (in diameters) of straight duct run. It seems valuable, however, to survey the losses in certain duct system elements, using an elementary approach.

The fundamental energy equation for steady flow in a horizontal duct can be written:

$$p_1 + (V_1^2/2g) = p_2 + (V_2^2/2g) + H$$

where H = loss of head.

It states that the mechanical energy at a given point must be equal to the mechanical energy at another point plus any dissipation of mechanical energy to internal energy (loss of head). At both points the mechanical energy consists of the static head or static pressure p and the velocity head or velocity pressure $V^2/2g$. The sum of static pressure and velocity pressure is the total head or total pressure. It should be noted that the above energy equation is only valid if no work is done by or upon the air between reference sections "1" and "2" and if there is no heat transfer to and from the air.

For standard air, the energy equation changes to

$$p_1 + (V_1/4005)^2 = p_2 + (V_2/4005)^2 + H$$

In this equation, p is a measure of the potential energy and $(V/4005)^2$ is a measure of the kinetic energy or energy of motion. Both are mutually interconvertible; that is to say, static pressure may be transformed into velocity pressure and

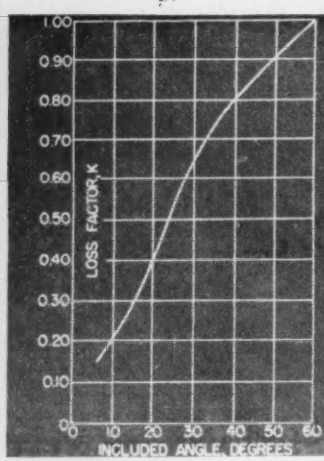


FIG. 5—When the cross section area of a duct is gradually increased, the total included angle should be about 7 deg for circular ducts and for rectangular four-sided expansion

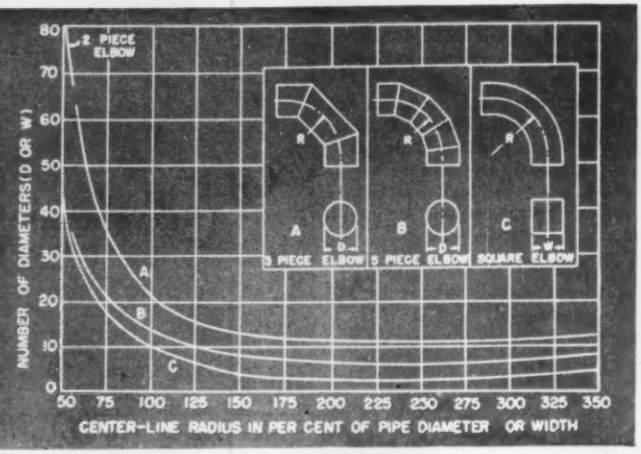


FIG. 6—Number of diameters or widths of duct having frictional resistance equivalent to pressure drop in elbows. Curve A should be used when there is doubt as to quality of duct construction

vice versa. Such transformations are always accompanied by a loss of total head.

Abrupt contraction of a duct causes a drop in static head due to an increase in velocity head and to turbulence. With no friction (loss of head = 0), the last equation above changes to

$$p_1 + (V_1/4005)^2 = p_2 + (V_2/4005)^2$$

$$p_1 - p_2 = (V_2^2 - V_1^2)/4005^2$$

There is a fluid friction, however, which causes a loss in total head that depends on the ratio of the areas of the two cross sections. For a round duct changing in area from A_1 to A_2 (Fig. 3), the loss in total head can be expressed as

$$H = k(V_2/4005)^2$$

The factor k is called the coefficient of loss (or discharge) and has values as follows:

A_2/A_1	0.1	0.2	0.3	0.4	0.5
k	0.48	0.46	0.42	0.37	0.32
A_2/A_1	0.6	0.7	0.8	0.9	1.0
k	0.26	0.2	0.14	0.07	0

Abrupt enlargement of a duct (Fig. 4) causes a loss in head due to the impact of the fast moving air against the slow moving air. The following equation has been developed and verified by actual test:

$$H = (1 - A_1/A_2)^2(V_1/4005)^2$$

$$= [(V_1 - V_2)/4005]^2$$

If the cross section area of a duct is gradually increased, the loss of head will be smaller than in the equation above. In this case, the decrease of velocity is accompanied by a conversion of velocity head into static pressure head. The conversion (or regain) is not complete, and the loss of total head depends upon the slope of the sides of the duct. For circular ducts, and approximately for rectangular ducts, the loss of head due to gradual enlargement can be expressed as

$$H = K(1 - A_1/A_2)^2(V_1/4005)^2$$

$$= K[(V_1 - V_2)/4005]^2$$

The coefficient of loss K depends upon the included angle. For circular ducts, the coefficient is as follows:

Total included angle, deg	7	10	20	30
Coefficient	0.15	0.20	0.40	0.65
Total included angle, deg	40	50	60	
Coefficient	0.80	0.92	1.0	

For minimum total loss of head, the total included angle should be about 7 deg for circular ducts and for rectangular four-sided expansion. For expansion on two sides only of a rectangular duct, the optimum included angle is about 10 deg.

In Fig. 5 K is plotted against the included angle. The graph shows, that no regain of static pressure occurs when the included angle reaches 60 deg. The loss of head is then the same as for an abrupt enlargement.

The above formula applies only approximately for rectangular ducts because the loss varies also with the area ratio.

The loss of head in elbows is usually expressed as equal to a number of diameters of round duct, or a number of widths of rectangular duct or equivalent length of duct. The curves in Fig. 6 give the number of diameters or widths of duct which have a frictional resistance equivalent to the pressure drop in the elbows. Curves *B* and *C* are based on tests of round and square elbows of ordinary good sheet metal construction. Values obtained from Curve *A* should be used when there is any doubt as to the quality of duct construction.

RESEARCH CLOSE TO OUR LIVES AND FORTUNES

SCIENTIFIC RESEARCH is tied more tightly than ever before to the lives and fortunes of the general public, not only because of such military developments as the atomic bomb but because of the steadily increasing flow of new ideas and products from the nation's laboratories, said Charles E. Wilson, president of the General Electric Co., at ceremonies in Schenectady, N. Y., dedicating the new quarters of the company's research laboratory.

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For the latest information on new and improved products, read the Equipment Developments columns in Heating, Piping & Air Conditioning each month.

Methods of Making

PIPING FLEXIBILITY

Analyses

By Theodore E. Bridge

Many ways of analyzing the flexibility of piping systems have been developed, and there has been a great amount of material on the subject of piping flexibility published. The numerous methods available are confusing unless one has made a thorough study of all of them over a period of years; in fact, one piping designer has suggested to the editor that some authority should "standardize" one method and "require all engineers to use it." . . . . In order to assist those who must analyze piping flexibility in order to design and install piping systems, HPAC has published a number of articles in which the advocates of the various methods have described their respective merits, each author using his method to work out the same typical problems in order that the reader may judge for himself the suitability of the different calculation procedures in his own piping work. This month, Mr. Bridge solves these problems by the method which he has described in his recent articles in our pages.

SOME TIME AGO, an invitation was presented in Heating, Piping & Air Conditioning to the various writers on piping flexibility to solve two typical problems. In response to this invitation, in the June 1946 HPAC, a number of articles have been published on various methods of making piping flexibility analyses. It seems logical, therefore, to solve these same two problems by the method advanced by the author in the articles in the October 1950—January 1951 issues, inclusive. It is hoped that the simplicity of the method will be apparent from a study of the solutions presented. The error made as a result of the simplifications employed will also be apparent by comparison with the answers obtained from some of the more refined methods.

Solving the Single Plane Problem

The moment area M for the single plane problem is calculated in Fig. A, shown here. If it is desired to calculate the force on the basis of a square corner assumption, the moment area obtained for the straight pipe may be used in equation 23 [page 97, November issue] as follows: $F = Z'' \cos C\ E\ I\ /\ 1728\ M = 6.23 \times 0.992 \times 25 \times 244.8 / 1.728 \times 5.815 = 3750$ lb.

If it is desired to refine the calculation further to allow for flattening effect at the elbows, a value for $Lb = 7$, the equivalent length of each elbow, is obtained from Fig. 12 [page 94, December issue]. This multiplied by the sum of the distances from the thrust axis squared ($Yc^2 + Ye^2$) will give the moment area of the elbows. This is added to the moment area of the straight pipe and substituted into equation 23 to calculate the force F as was done in Fig A. ($F = 2710$ lb).

The above force may be resolved into components in the X and Y directions if desired for comparison with the results obtained from other methods. $Fx = 2710 \cos 22^\circ =$

Mr. Bridge acquired a wide experience in the design of power and process piping during 15 years with E. I. du Pont de Nemours & Co., and has also had experience in the field of very high pressures. At the time he prepared this article, he was a mechanical engineer with the University of Chicago in connection with a project under construction for the Argonne National Laboratory; he is now associated with Tube Turns, Inc. He has taught several other engineers to use the method described here in figuring flexibility of piping systems, and they have found it as useful as has he. Theory of the method was reviewed in the October, November and December issues of HPAC, and the procedure to follow in solving problems was given—with examples—last month.

2500 lb. $Fy = 2710 \sin 22° = 1020$ lb.

The above values are about 5 percent lower than those obtained from some of the more accurate methods previously published. In this solution, the thrust axis was located entirely by eye in accordance with the instructions given in preceding installments of the present author's articles.

The stress S is calculated from equation 16 [page 94, November issue]: $S = 6\ F\ Y_{max} D'' / I$. Y_{max} is 13.2 at point e on Fig. A: $S = 6 \times 2710 \times 13.2 \times 10.75 / 244.8 = 9400$ psi. The above stress should be multiplied by β to allow for stress concentration in the elbow: $S = 9400 \times 1.76 = 16{,}500$ psi.

The bending moment calculated at elbow point e is: $12\ Ye\ F = 12 \times 13.2 \times 2710 = 430{,}000$ in.-lb, which is about 2 percent lower than the moment obtained from some of the more accurate methods.

Solution of the Three Plane Problem

The three plane problem is solved in Fig. B. In this problem, the radius of the pipe bends is large in relation to the dimensions of the system, and it is necessary to approximate the bend with a chord at 45 deg having approximately the same length as the bend. The moment area for the straight pipe is figured as in the other examples.

The force may be calculated from equation 23, as before, using only the moment area of the straight pipe to obtain an answer based on a square corner assumption: $F = Z''$ cos $C\ E\ I / 1728\ M = 1.2 \times 0.98 \times 24 \times 33.14 / 1.728 \times 0.1804 = 3000$ lb.

This force may be resolved into components for comparison with other solutions approximately as follows: $Fz = 2000$; $Fx = 2010$; and $Fy = 890$.

The above values are about 15 percent higher than similar values obtained from the more refined methods of calculating piping flexibility.

Correcting for Flattening Effect

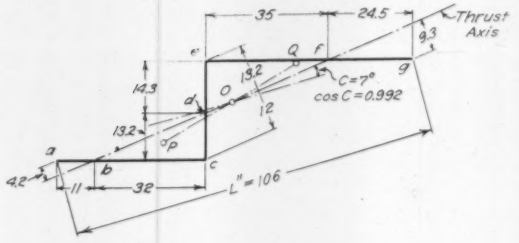
The three plane problem may also be corrected for flattening effect if desired. This correction becomes quite involved due to the fact that only partial credit may be taken for flattening effect at bends which are not in pure bending. An examination of Fig. B shows that the bend at corner cde is almost in pure bending. It will be seen from the plan that the edge view of this bend lines up at a very slight angle with the thrust axis. This is proof that the bend is subjected to very little twisting, therefore full credit may be taken for flattening at this bend: $Mb = Lb\ Ye^2 = 5.09 \times 11.6 = 59$ ft^3.

A similar analysis will show that the bend at corner fgh is tilted out of the plane containing the thrust axis at an angle of about 45 deg. In looking at the plan view, it will be remembered that the thrust axis is tilted upward at an angle of about 45 deg. This means that it is permissible to take only about 70 percent of the length Lb as the effective length of the bend. (70 percent is approximately the cosine of 45 deg.) The moment area for this bend will be: $Mb = 0.7Lb\ Yg^2 = 0.70 \times 5.09 \times 36 = 12.8$ ft^3.

The moment area for both of the above pipe bends will be the total of these two values: $Mb = 59 + 12.8 = 71.8$ ft^3. This is added, in Fig. B, to the moment area of the straight pipe, and the force $F = 2150$ calculated. This force may be resolved into components as before if desired for comparison with similar values obtained from other methods: $Fz = 1440$; $Fx = 1445$; and $Fy = 640$ lb. These values are about 18 percent low when compared to more accurate methods.

The above comparison makes one question the wisdom of correcting this short-cut method for flattening effect when solving three plane problems. The correction is somewhat

Fig. A — One-plane problem



Temperature Range, 60F to 725F

	Y	Y'	Y"	(Y')"	L"	3M
a	4.2	74				
			4.2	74	11	194
b	0	0				
			12	1728	32	4600
c	12	1728				
			12	1728	13.2	1900
d	0	0				
			13.2	2300	14.3	2490
e	13.2	2300				
			13.2	2300	35	6100
f	0	0				
			9.3	820	24.5	2160
g	9.3	820			3	17444

Straight Pipe, M=5815

2 Elbows, $M_b = L_b(Y_c'^2 + Y_e'^2) =$
$7(12^2+13.2^2) = 7(144+175) =$ 2220

Total = 8035

D"=10.75, t=0.593, D=10.16
I=244.8, E=25,000,000
Z"=106 x 0.0588 = 6.23

From Fig. 12, $L_b = 7$

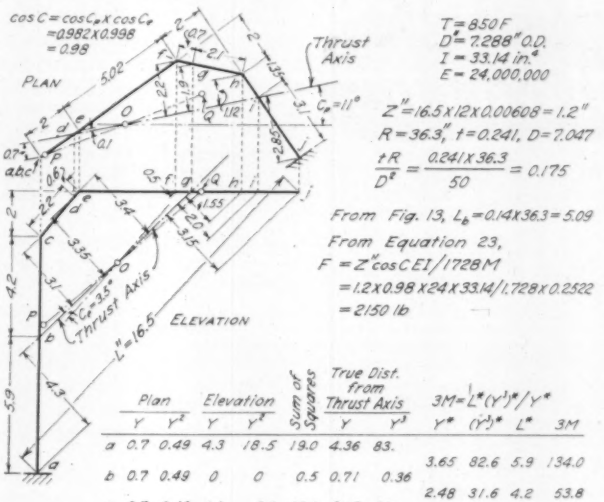
$$h = \frac{4tR}{D^2} = \frac{4 \times 0.593 \times 15}{103.2} = 0.345$$

$$K = \frac{244}{11.44} = 0.214$$

$$\beta = \frac{0.667}{K}\sqrt{0.392h^2 + 0.278} = 1.76$$

Equation 23, $F = Z'' \cos C\ EI/1728M$
$= 6.23 \times 0.992 \times 25 \times 244.8 / 1.728 \times 8.035$
$= 2710$ lb

Fig. B — Three-plane problem



	Plan Y	Plan Y²	Elevation Y	Elevation Y²	Sum of Squares	True Dist. from Thrust Axis Y	True Dist. from Thrust Axis Y³	3M = ½L*(Y³)*/Y* Y*	(Y³)*	L*	3M
a	0.7	0.49	4.3	18.5	19.0	4.36	83.				
								3.65	82.6	5.9	134.0
b	0.7	0.49	0	0	0.5	0.71	0.36				
								2.48	31.6	4.2	53.8
c	0.7	0.49	3.1	9.6	10.1	3.19	32				
								0.16	5	2.2	69.0
d	0	0	3.35	11.2	11.2	3.35	37				
	Use Equation 15							(3x11.4x0.6)			20.5
e	0.1	0.01	3.4	11.6	11.6	3.41	39.5				
								1.16	28.1	5.02	122.0
f	2.2	4.85	0.5	0.25	5.1	2.25	11.4				
								0.35	4.6	0.7	9.2
g	1.9	3.6	0	0	3.6	1.9	6.8				
	Use Equation 15							(3x3.6x2.1)			22.6
h	1.12	1.25	1.55	2.4	3.6	1.9	6.8				
								0.1	1.2	1.35	16.2
i	0	0	2.0	4.0	4.0	2.0	8.0				
								2.25	68.0	3.1	94.0
j	2.85	8.1	3.15	9.9	18.0	4.25	76			3	541.3

Straight Pipe, M = 180.4
2 Pipe Bends, M_b = 71.8
Total, M = 252.2

indirect; and, as is evidenced in this problem, unsafe answers can be obtained.

It is, perhaps, fortunate that such an answer was obtained for this problem. The author does not claim high accuracy for this method. The flattening effect correction was applied to this problem to show how it could be done if desired. For large diameter, thin wall pipe, this correction might become very large. It is not uncommon, in such problems, to find the moment area from flattening effect greater than the moment area in all of the straight pipe put together. For the usual three plane problem, however, the author does not recommend that a flattening effect correction be applied.

The proposed short-cut method, though inexact, has many applications in everyday engineering practice. It is frequently cheaper to design a system that is more flexible, than it is to calculate accurately the flexibility. In any case, the short-cut method may be used to point out borderline cases which may require further study by one of the more exact methods of analyzing piping flexibility.

Symbols Used in This Article

C is the angle between the thrust axis and a line joining the anchors.

Cp is the angle *C* projected into the plan view.

Ce is the angle *C* projected into the elevation view.

D is the mean diameter of the pipe, in.

D" is the outside diameter of the pipe, in.

dL is the length of a very short element of pipe, ft.

e is the coefficient of expansion of the material of which the pipe is made.

E is the modulus of elasticity of the material in the pipe, psi.

F is the force applied to the rigid arm to simulate the effect of anchoring the pipe.

h is a constant $= 4tR/D^2$

I is the moment of inertia of the pipe cross-section, in.⁴

K is a constant $= (1 + 12h^2)/(10 + 12h^2)$

*L** is the length of straight pipe between two reference points, ft.

Lb is the net equivalent length of a pipe bend, ft.

M is the moment area, ft³. $M = \int Y^2\,dL$

Mb is the moment area added by flattening effect at a pipe bend, ft³. It is the net increase in moment area over that already included in a square corner assumption.

R is the radius of the centerline of a pipe bend, in.

S is the maximum bending stress in the pipe caused by thermal expansion.

T is the difference between the operating temperature and the temperature at which the pipe is installed, deg Fahr.

t is the wall thickness of the pipe, in.

Y is the perpendicular distance from the element of pipe *dL* to the thrust axis, ft.

*Y** is the arithmetic difference between two successive values of *Y*. It is always taken as plus.

$(Y^3)^*$ is the difference between the cubes of successive values of *Y*. Note that it is not the cube of the difference.

Z is the deflection of the rigid arm parallel to thrust axis, in.

Z' is the deflection of the rigid arm measured perpendicular to the thrust axis, in.

Z" is the vector sum of *Z* and *Z'*, in. $Z'' = e\,T\,L''$. The product $(12\,eT)$ is given as data in Figs. A and B.

β is a stress multiplier to correct for the concentration of stress which occurs when a pipe bend flattens.

QUESTION of the Month

ARE CEILING PANELS O.K. IN SEVERE CLIMATE?

IN A QUESTION published in these pages some months ago, "R.P.," a consulting mechanical engineer, asked about the advisability of installing ceiling type radiant panels without providing a floor panel where the buildings are situated on a compacted sand fill using a 4 in. concrete slab as the floor, and where the climate is severe.

From the heat loss calculation standpoint, he said, under certain conditions sufficient panels can be provided in the ceilings without going to auxiliary panels in the walls or floor.

However, the question comes to mind that trouble may develop along the outside walls of installations of this nature where conditions would be such in extreme weather that moisture and frosting would occur under extreme conditions of minus 30 F even though a strip of 1 in. rigid insulation were provided between the footings and the floor around the outside perimeter of the building, he said.

REPLYING TO "R. P."s question, I am quite sure that he will agree that it would be unwise to predict what may or may not happen under conditions where many variables exist. We may, however, probably safely generalize to a certain extent.

In considering the possibility of frosting on glass areas or floor surfaces the important objective, of course, is to prevent the temperature of the surfaces from falling below the dew point. This can generally be accomplished by the use of double glazing and suitable insulation. If the insulation of a floor slab does not extend completely under the slab, it should extend along the perimeter inside of the foundation walls and down to the footings. A suitable moisture barrier below the floor slab would also be advisable.

Conditions in two installations under our observation during the past heating season may be of interest. One of these installations was in a metallurgical research building having a 4 in. concrete floor slab laid directly on gravel fill. The humidity conditions in this building are rather high at certain times, yet no frosting of the windows occurred. One of the windows had outside storm sash. The temperature of the ground 20 in. below the bottom of the floor slab and 4 ft in from the outside wall determined by thermocouples never exceeded 64 F. The floor slab was unheated.

The second installation was in a structure having large double glass windows in one room extending from a short distance above the floor to the ceiling. All other windows were equipped with storm sash. There was an unheated 4 in. concrete floor slab laid directly on gravel fill. No condensation or frosting occurred on the inside of any of the windows during the last heating season, but on one or two occasions slight frosting occurred on the inside of the storm sash at the bottom but it was not in the slightest degree objectionable.

During the last heating season the outdoor temperature reached −20 F several times. — D. L. M.

ANSWERING THE questions from "R. P.," I have no knowledge of frost appearing on the inside surfaces of exterior walls in rooms that have enough radiant coils in the ceilings, no matter how cold may be the outdoor temperature.

I have not heard of this trouble, after several years experience with overhead radiant heating in dozens of plants. The temperature of the floor easily is maintained by the heat rays from the ceiling and only in plants where floor coils are employed, has it been our custom to install an insulating barrier between the floor and the footings of the outside wall.

Occasionally, we encounter a room that has so great a heat loss that it becomes impractical to place a sufficient area of radiant coils in the ceiling. Under such circumstances we do not hesitate to use auxiliary radiant surface in the floor or in side walls.

I anticipate that complaints may come from installations where the sub floor is not kept dry. Footing drains for all buildings always have been desirable and should especially be required if radiant pipe coils are to be placed in a concrete or tile floor that rests directly on the ground. — S. R. L.

ASKS HELP ON HOSPITAL HEATING

YOU ARE INVITED to answer the following question from a reader of HPAC. Suitable comment on the matter will be welcomed and — space permitting — will be published. Address your reply to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"I am the maintenance manager of a hospital. Our building is rather an old one. The north wing has been rebuilt inside from the ground up — basement, first and second floor. I have a low pressure stationary boiler in which has been installed a fuel oil burner, with all the new safety devices such as an electric water level control and vacuum return. The thermostatic control is located on the second floor.

"Our weather usually is fairly mild, and the boiler does not operate continuously, but intermittently.

"In the rebuilt wing are installed convector type radiators. The balance of the building, except the surgical suite, has old cast iron radiators. All radiators are vented.

"We have much too great a differential in inside temperatures between the floors, as is shown by the following readings taken on December 21, 1950: Outside temperature, 24 deg. Inside temperature, basement 82 deg; first floor, 82 deg; second floor, 80 deg; lobby of surgical suite, 72 deg; surgery room 68 deg; and delivery room 68 deg.

"It appears that, within a matter of minutes after the boiler cuts off, the convectors are cold while the cast iron radiators stay hot as long as 30 to 40 min. Can any solution to my problem be suggested?" — C. H. B.

Sam Lewis' Page

..... practical comment on everyday problems

INFORMAL COMMENT on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors.

HERE'S MORE DATA ON BURNING WOOD

IN REACTION TO the remarks I made on my "Page" in the December HPAC concerning transporting and burning wood, in order to destroy it as well as for heat conservation, the following additional information has been gleaned:

The chimney draft should be held very closely to 0.1 in. and if there is a tendency, as from wind or from too tall a chimney, to exceed 0.1 in., a barometric excess draft damper should be installed.

If the sawdust has 3500 available Btu per lb and up to 60 lb per hr can be burned per sq ft of grate area, and if about 70 percent efficiency can be attained, then 3500 times 60 equals 210,000 Btu times 0.70 equals 147,000 Btu per sq ft of grate. In general, given good draft conditions, the 60 lb per hr rate of combustion per sq ft of grate can be doubled.

The air for combustion should be introduced at the proportion of about 10 percent under the grates and 90 percent above them and around the burning cone of sawdust. The 90 percent proportion of the air is most effective if it causes turbulence to help carry away the fluffy ash that tends to form on the surface of burning wood.

Creosote will be deposited in the chimney due to condensation of the vaporized oil that follows combustion of wood. The oil, in gaseous state when it leaves the fire, changes state rapidly to a liquid when it loses heat. Thus, it is desirable to maintain a continuous burning rate and to minimize periods of intermittent cooling with the attendant creosote.

The breeching between the boiler and the chimney should be insulated effectively, and a chimney that rises through a heated building is preferable to a metal chimney exposed to the outer air.

Tests by Oregon State College on wood waste indicate the average moisture content of such waste to be somewhere between 40 and 50 percent.

HOW WE SIZE CHIMNEYS

ONE OF THE readers of my "Page" wrote me recently that he had been interested in a discussion several months ago regarding the problems involved in gas conversions of old boilers. He asked if I could direct him to a source of information on the selection of chimney sizes for burning coal, oil and natural gas. He pointed out that, from my discussion of the matter, there is obviously a difference in the draft requirements for the various fuels, but that boiler manufacturers often give arbitrary chimney diameters and heights for the different sizes of boilers, and that probably a majority of chimneys are sized from such recommendations.

In reply to this request, the Heating, Ventilating, Air Conditioning Guide, published by the American Society of Heating and Ventilating Engineers, has a profound discussion of chimney sizes, but I am inclined to think that some of its profundity is perhaps unnecessary.

The fact is that no matter what fuel we try to burn in a boiler as of today we may be compelled to burn some other fuel—due to the war or the miners' unions or new gas pipe lines—long before the boiler will be worn out. There is general agreement that to burn coal requires the most potent chimney and that such a chimney will allow use of oil or wood or gas, provided that if gas be used, protection shall be made against damage to the chimney due to the moisture that accompanies its combustion.

Our custom is to make the chimney large enough for coal, and if gas or oil temporarily are to be used, to omit the upper part of the chimney that might be required for coal. Usually the height using oil or gas would be limited to that which would avoid down drafts from wind eddies caused by the roof construction.

If at some future time coal must be burned, the chimney can be extended.

MR. LEWIS HONORED BY HIGH AWARD

Regular readers of Sam Lewis' Page, published in Heating, Piping & Air Conditioning each month, will be pleased to learn that its author is the recipient of one of the highest honors that can come to a man of his profession—The F. Paul Anderson Medal, which is awarded by the American Society of Heating and Ventilating Engineers.

This medal is given "in recognition of notable scientific achievement or outstanding services performed in the field of heating, ventilating, or air conditioning." Its previous recipients include Dr. Willis H. Carrier, Dr. Arthur C. Willard, Prof. Frank B. Rowley, Dr. F. E. Giesecke, Dr. F. C. Houghten, Alfred E. Stacey, Jr., J. H. Walker, and Dr. C.-E. A. Winslow.

DATA *sheet*

Determining Pressure Drop, Flow Rate and Pipe Size for Steam Lines

THE FANNING FORMULA for the flow of steam can be written in the form:

$$\Delta P_{100} = C_1 \; C_2 \; C_3 \; V$$

where C_1 = discharge factor (from Fig. 1);
C_2 = size factor (from Table 1);
C_3 = viscosity factor (from Fig. 2);
ΔP_{100} = pressure drop per 100 ft of pipe, lb per sq in.;
V = average specific volume of steam (from steam tables).

The typical examples given below demonstrate how this formula and the accompanying data can be used to determine pressure drop, rate of flow and minimum pipe size for different steam services.

How to Find Pressure Drop

Problem: Find the pressure drop in 100 feet of 8 in. standard (Schedule 40) pipe if the steam pressure and temperature are 360 lb per sq in. absolute and 500 F, respectively. The discharge is 240,000 lb per hr.

Solution: From the tables and figures, the following values are found: $C_1 = 26.7$, $C_2 = 0.263$, $C_3 = 0.996$, and $V = 1.45$. If we put these values in the steam flow formula and solve, we find: $\Delta P_{100} = 10.14$ lb per sq in. per 100 ft.

Finding the Rate of Flow

Problem: Find the rate of flow, in lb per hr, in a 4 in. Schedule 40 pipe if the pressure drop is 8 lb per sq in. per 100 ft. Saturated steam at 150 lb absolute pressure is flowing in the pipe.

Solution: From the given conditions and the tables and figures we find $\Delta P_{100} = 8.0$, $C_2 = 7.73$, $C_3 = 0.972$, and $V = 3.0$. If we substitute these values into the steam flow formula and solve for C_1, we get $C_1 = 0.355$. By referring to Fig. 1, the discharge for this value of C_1 is found to be 23,600 lb per hr.

How to Determine Pipe Size

Problem: Find the smallest size of Schedule 40 (standard) pipe that can be used for a process requiring 20,000 lb per hr of saturated steam, if the initial steam pressure is 100 psi absolute and the maximum allowable pressure drop is 10 lb per sq in. per 100 ft of pipe.

Solution: From the given conditions and the tables and figures: $\Delta P_{100} = 10$, $C_1 = 0.257$, $C_3 = 0.96$, and $V = 4.432$. Substituting these values in the steam flow formula, and solving for C_2, it is found that $C_2 = 9.2$. From the table, 4 in. Schedule 40 pipe is the smallest size that will provide a value of C_2 less than the calculated value. The actual pressure drop per 100 ft of 4 in. Schedule 40 pipe may now be calculated as 8.5 psi by solving the steam flow formula using the table value of 7.73 for C_2.

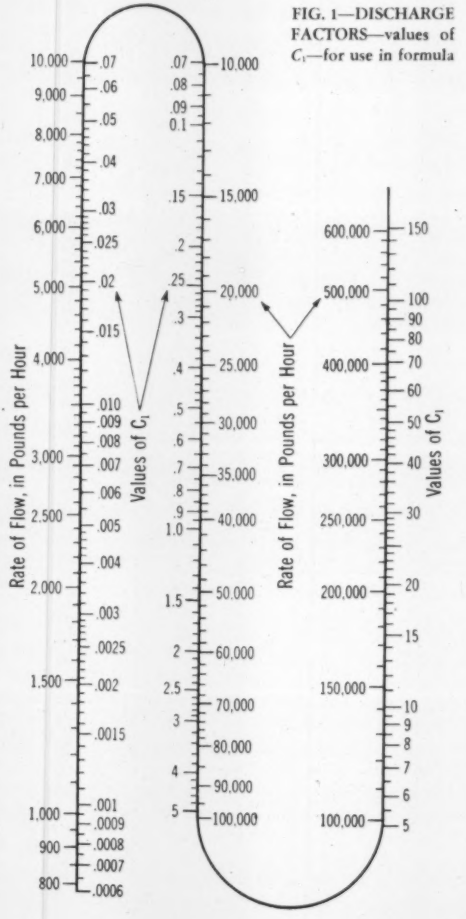


FIG. 1—DISCHARGE FACTORS—values of C_1—for use in formula

Published by courtesy of Crane Co.

TABLE 1—SIZE FACTORS—values of C_2—for use in formula

NOMINAL PIPE SIZE INCHES	SCHEDULE NUMBER OF PIPE	INTERNAL DIAMETER OF PIPE INCHES	VALUE OF C_2	NOMINAL PIPE SIZE INCHES	SCHEDULE NUMBER OF PIPE	INTERNAL DIAMETER OF PIPE INCHES	VALUE OF C_2
1	40	1.049	6420.	6	40	6.065	1.00
	80	0.957	10050.		80	5.761	1.28
	160	0.815	21950.		120	5.501	1.62
1¼	40	1.380	1687.		160	5.189	2.16
	80	1.278	2455.	8	30	8.071	0.249
	160	1.160	3935.		40	7.981	0.263
1½	40	1.610	755.		60	7.813	0.291
	80	1.500	1067.		80	7.625	0.328
	160	1.338	1860.		100	7.439	0.369
2	40	2.067	213.		120	7.189	0.435
	80	1.939	291.		160	6.813	0.568
	160	1.689	570.	10	30	10.136	0.0819
2½	40	2.469	80.1		40	10.020	0.0866
	80	2.323	121.		60	9.750	0.0980
	160	2.125	188.		80	9.564	0.109
3	40	3.068	31.2		100	9.314	0.1235
	80	2.900	40.9		120	9.064	0.141
	160	2.626	66.7		140	8.750	0.168
3½	40	3.548	15.0		160	8.500	0.193
	80	3.364	19.5	12	30	12.090	0.0344
4	40	4.026	7.73		40	11.938	0.0366
	80	3.826	9.91		60	11.626	0.0420
	120	3.626	12.8		80	11.376	0.0467
	160	3.438	17.5		100	11.064	0.0534
5	40	5.047	2.57		120	10.750	0.0615
	80	4.813	3.18		140	10.500	0.0690
	120	4.563	4.22		160	10.126	0.0823
	160	4.313	5.52				

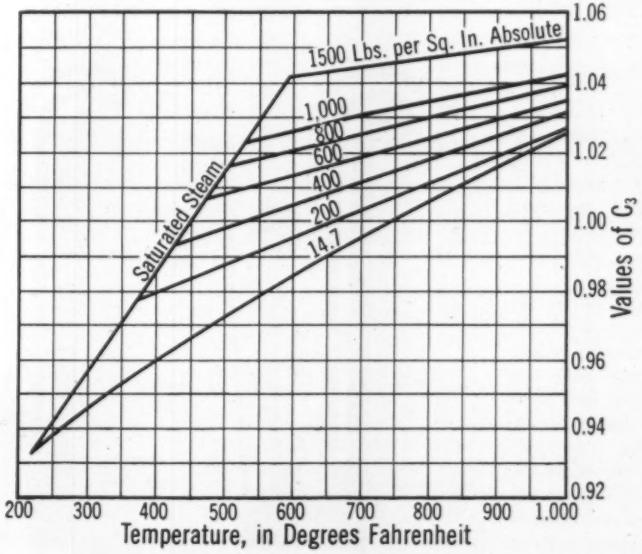


FIG. 2—VISCOSITY FACTORS—values of C_3—for use in formula

Principles of Air Conditioning

AIR CONDITIONING equipment comprises apparatus for providing the necessary heat and moisture exchanges within the room to be conditioned and of the air supplied to the room for ventilation, and automatic devices for governing such apparatus so that temperature and humidity may be controlled within the limits desired.

The latter are referred to as controls. Those for controlling temperature are known as thermostats, and those for controlling humidity are known variously as hygrostats, psychrostats or humidistats.

Apparatus for effecting humidity changes may be divided into two distinct groups:

1.) The humidifiers used for the purpose of increasing the moisture content of the air and to produce cooling by evaporation.

2.) The dehumidifiers used for the removal of moisture from the air and to produce cooling by contact with water or surfaces at a lower temperature than the air.

Humidifiers of the Direct Type

Humidifiers may be divided into the following general types according to the method of operation: (1.) Indirect (introduction of moistened air). (2.) Direct (spraying into the room). (3.) Combined (direct and indirect).

Before the advent of modern air conditioning, the direct type humidifier was largely used for increasing the humidity in cotton mills and similar places. There has been much improvement in this type of humidifier and they still find wide application, especially in the textile industry.

One of these types uses atomizer heads operated by compressed air in which the water is drawn into the nozzle and then finally atomized by a small jet of air under moderate pressure.

In another type, water is supplied at high pressure to an atomizing nozzle. This nozzle is located in a sheet metal enclosure suspended from the ceiling through which a current of air is caused to pass, either by the action of a motor-driven disc fan or by the induction action of the spray itself. The heavier particles of water are separated by a simple method of baffling and only the very finest particles are caused to pass into the room with the current of air where they are rapidly evaporated.

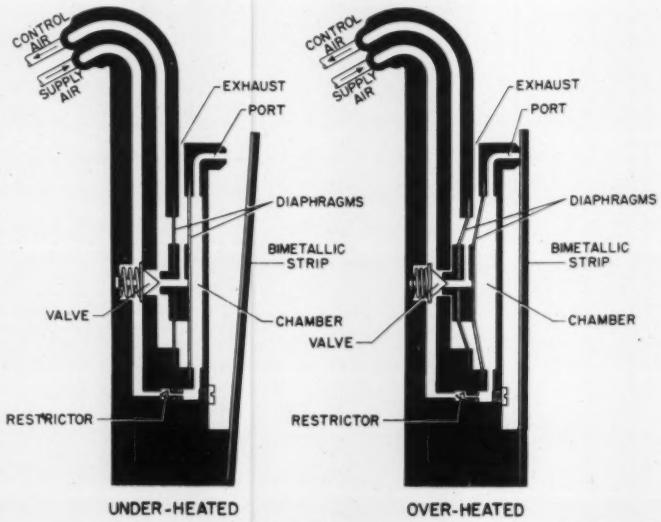
In a third type of direct humidifying head, a small jet of water is thrown upon a disc rotating at high velocity within a stationary circular comb which consists of fine metal strips or teeth against which the water thrown from the disc impinges. The finely atomized particles that are thus provided are carried out with the current of air created by a disc fan operated from the motor shaft.

The three types of direct humidifiers described are suitable only for application in certain types of industrial plants and do not provide either for controlled ventilation or for dehumidification, which is essential in many industries as well as for applications providing for human comfort.

Indirect Humidifiers and Their Use

Indirect humidifiers are similar in operation to spray-type air washers except that the water is sprayed directly against the incoming air. Such humidifiers comprise a chamber, usually from 6 to 10 ft in length, through which the air is drawn at a velocity from 500 to 700 fpm. Inside the chamber are placed one or more banks of spray nozzles distributed uniformly over the cross sectional area of the chamber. These nozzles create a finely divided spray through centrifugal action and require water

A BI-METAL thermostat of the pneumatic type

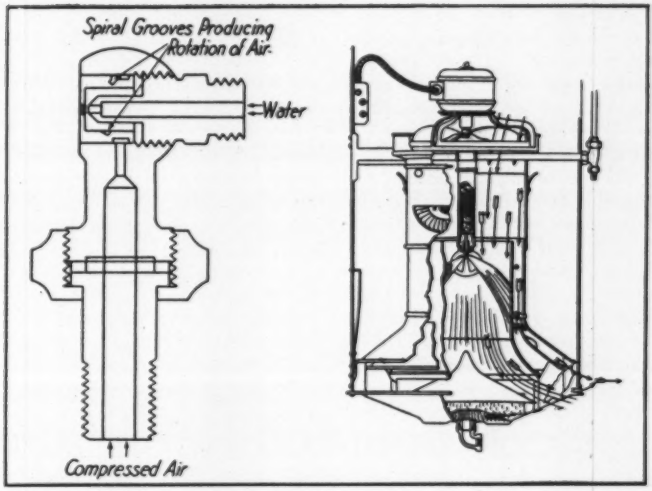


pressures for effective humidification of from 35 to 45 lb per sq. in. At the intake of the humidifying chamber a set of baffles distributes the air and prevents the spray from escaping from the chamber, while at the outlet of the humidifier chamber an eliminator is provided. This eliminator, consisting of a series of metal baffles, is so designed as to separate all of the free, unevaporated moisture from the humidified air. Thus, the air leaving the humidifier is completely saturated, but without entrainment or unevaporated water particles.

Such humidifiers are used only in connection with ventilating systems. They are practically always placed on the inlet side of the ventilating fan. Provision is made for warming the water in winter so that the air may be saturated at a definite temperature. The heating of the water is usually controlled by means of a thermostat placed in the path of the saturated air leaving the humidifier and controlling the heater through which the spray water passes.

In other cases, particularly in industrial work where high humidities are maintained, the control of the dew point temperature is effected by a thermostat controlling the mixture of outside air and return air from the building by means of outdoor air and return air dampers at the inlet of the humidifier.

In industrial work, the dew point regulation is effected in winter time by both these means operating in conjunction. Where all outside air must be employed, it is usual to provide in front of the air washer, preheater coils of sufficient capacity to bring the air to a temperature slightly above the freezing point. In summertime operation, whenever the outside wet bulb temperature is above the minimum dew point desired in the building, all outside air is taken and, it will be remembered from the psychrometric principles previously discussed, that the air issuing from the humidifier will have been cooled to the wet bulb temperature of the entering air, provided, of course, that the water is neither heated nor cooled by recirculation, which is usually the case in such installations.



LEFT—A direct type humidifier head. RIGHT—Another type of humidifier head

Humidity Control in Process Work

In most manufacturing processes, relatively little moisture is added to, or extracted from, the air in the room by the process itself and, as windows and doors are closed, conditions in the room rapidly stabilize to the moisture content of the entering air. Thus, it is possible to control the relative humidity within the room by proportioning the quantity of the air in accordance with the heat sources within the room, such as heat from machinery and the occupants, electric lights, sunlight and outside radiation. The quantity of air to be supplied for each unit of heat thus removed is definitely dependent upon the relative humidity to be carried. For example, if 50 percent relative humidity is to be carried in the room, the ventilation must be restricted so there shall be a rise of 20 F between the entering air and the air in the room itself. Smaller rises would give increased relative humidities.

In textile mills, for instance, with the humidities usually carried, it is possible to keep the room temperature within about 12 F of the outside wet bulb temperature. Inasmuch as the wet bulb temperature on hot

The late Willis H. Carrier, chairman emeritus of the board, Carrier Corp., honorary member, life member and presidential member of the American Society of Heating and Ventilating Engineers, prepared (with the assistance of a committee appointed by the ASHVE) and presented at the 1929 World Engineering Congress at Tokyo an extensive paper on air conditioning for process and comfort which was published in the November 1929 issue of HPAC. Because of its importance and its thorough treatment of the subject, HPAC's editors recently asked Dr. Carrier to bring it up to date for publication now that "air conditioning has come of age." Those familiar with air conditioning 20 and more years ago will find this a "refresher course", and those unfamiliar with the development of the art in its early days will obtain much of value for present-day use. . . . The first part appeared in the April issue, the second in June and the third in August 1950.

days is usually 15 to 25 F lower than the dry bulb temperature, the mill temperature will be below the outside temperature and provision has to be made for the heat absorbed by inward transfer of heat through the walls.

The type of humidity control described is usually known as the *dew point* control and is particularly applicable where there are a number of different departments to be served from one central equipment, and where there is but little change in the moisture content of the air in the room due to moisture changes in the materials processed or to excessive air leakage from outside.

Another system that is used considerably, especially where there is but one room to be controlled from one apparatus and where there may be considerable moisture change in the room itself due to local conditions, is to vary the dew point at the apparatus, either continuously or intermittently, by means of a hygrostat placed in the room and so connected as to vary either the temperature or quantity of spray water used in the humidifier, or both. This system may be designated as the *direct relative humidity* control.

In such installations, the temperature and humidity are both under control during the heating season, and in the summertime the humidity must be maintained constant but the temperature must be allowed to rise in accordance with the increase of the wet bulb temperature above the minimum desired. Temperature variations under mill conditions will be from 75 to 90 F. Such results are much superior from the standpoint of comfort and well-being of the operators than those previously experienced. This has resulted in greatly increasing the effectiveness of the workers during this period, but the amount of ventilation provided has also greatly improved conditions in mills as to dust, lint, and odors. In the spinning of fine cotton yarns, this is of great value in producing an improved product as well as in bettering working conditions in the mill.

The positive circulation of air results in the lowering of the effective temperature with a consequent increase in comfort and efficiency of the workers at temperatures and humidities which are necessarily high because of the requirements of the product. The motion results also in removing the heat directly and immediately from the point of production on the spinning frame thus avoiding localized increase of temperature and decrease of relative humidity. In other words, it permits the entire process to be subjected more nearly to the average room conditions.

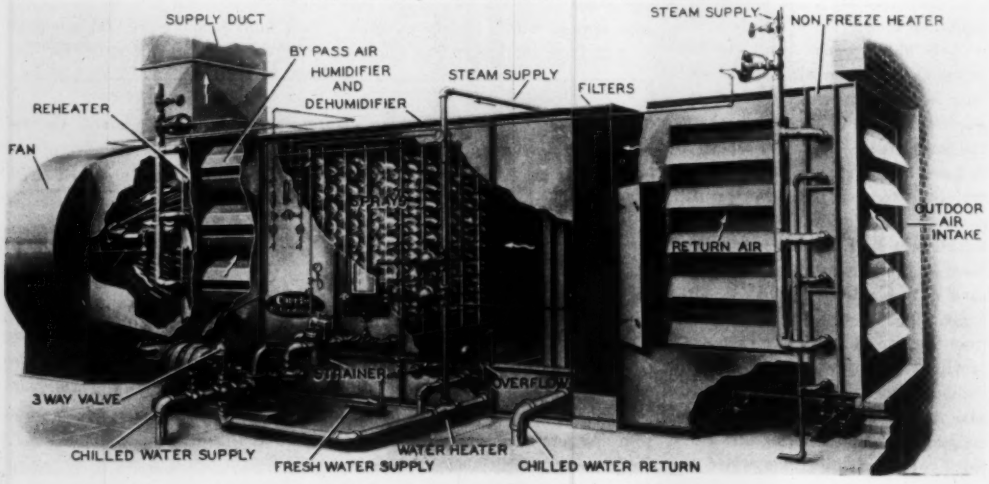
Application of Direct and Indirect Methods

Where large quantities of power are generated in a limited space, and where higher than 60 percent relative humidity is required, it is feasible and economical to use a combination of direct and indirect humidification. The indirect humidification is for the purpose of securing the desired quantity of ventilation and cooling, and the additional direct humidification placed in the rooms to increase the humidity and, at the same time, secure additional cooling effect. In general it may be stated that direct humidification is most satisfactory where higher humidities with but little cooling or ventilation are required.

Therefore, the indirect system is best where lower relative humidities with maximum cooling and ventilating effects are desired, while for conditions where there are both large quantities of heat to be absorbed by ventilation and high humidities are needed the combination system of direct and indirect is more desirable.

Inasmuch as the cooling and humidification requirements in summer are much more severe than those in winter, an excess of humidifying and cooling capacity must be provided to meet extreme conditions and this requires, for the best results, careful automatic control.

SCHEMATIC drawing of a central station air conditioning system



Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL SECTION

The Efficiency of Bituminous-Coal-Burning Space Heaters†

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SUMMARY—This paper presents the results of tests which were run to obtain the efficiency and the unaccounted-for losses, over a wide range of burning rates, of two deep-fire-pot heaters, of a smokeless heater, and of a conventional surface-fired heater when burning high-volatile bituminous coal. All heaters were commercial models.

A description of a specially constructed calorimeter room in which the tests were run is included; this room permits an accurate determination to be made of the heat losses in the form of smoke and unburned tars and gases which, in the past, in conventional tests, have been termed the unaccounted-for loss.

Data on the useful heat transmitted to a room from a typical flue-pipe installation are also presented; and curves are given, for the four heaters tested, showing overall house-heating efficiency when the useful heat from the flue pipe, plus that from the chimney, are taken into account.

SEVERAL methods for rating coal-burning heaters have often been proposed, but none has the advantages of using a so-called calorimeter room designed specifically for this purpose. The true rating of space heaters requires a direct measurement of the output, obtainable in such a room, inasmuch as the magnitude of the unaccounted-for losses inherent to the burning of bituminous coal can only be determined by difference from a heat balance involving all known heat losses, the measured heat output, and the known heat input. The quantity of unaccounted-for heat required to complete the balance is, of course, the loss in unburned fuel escaping with the flue gases.

As a part of the program to evaluate improved heaters burning bituminous coal, Bituminous Coal Research, Inc., jointly with a group of stove manufacturers, authorized the construction of a test calorimeter room at Battelle Memorial Institute which is described later.

The object of the work discussed in this paper was to obtain the relation between heater efficiency and the rate of heat output, for the three general types of coal heaters currently being sold commercially; these are the conventional surface-fired type, the refractory-lined, (so-called magazine) deep-fire-pot type, and the crossfeed type smokeless stove. The scope of the work also included the determination of the added useful heat that is available within the house from the typical flue-pipe installation used between heater and chimney. Curves showing the overall house-heating efficiency that may be expected, when the heat gain from the flue pipe and from the chimney are taken into account, are presented for the heaters tested.

General Program of Tests

A total of four heaters, including two variations of the deep-fire-pot type, were tested in this program. The two deep-fire-pot heaters differed in the design of the inner refractory lining and were chosen as being representative of the several types now being manufactured.

The tests of these heaters and of the smokeless heater consisted of a series of burning cycles at different rates, but covering the normal range of operating rates of such units. The conventional surface-fired unit was tested at one rate only. Each test cycle for the first three heaters was run at a constant, preassigned flue-gas temperature which was varied from test to test. To maintain this temperature, the applied draft and air-inlet dampers were adjusted as often as necessary; furthermore, attention was given to the grates and to

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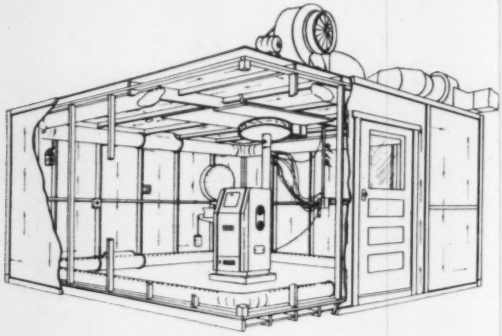


Fig. 1—Cutaway view of calorimeter room

the fuel bed as often as required. The only limitation imposed was that of not exceeding a maximum stack draft of 0.06 in. of water during any test.

Tests conducted in this manner, while deviating from the accepted procedure for output rating tests, permitted operation of the heaters on a basis which insured reproducibility of results, since flue-gas temperature is the variable in heater tests that can be most readily controlled.

Data presented for a conventional surface-fired heater in this paper were obtained from rating tests run several years prior to those conducted on the other three heaters. For that reason, the imposed limitations differed in that the flue-gas temperature was not held at a constant value, but, instead, was allowed to vary below a maximum of 900 F and there was no grate shaking or poking of the fuel bed; the same limitation was used on maximum draft. Performance curves plotted from the data obtained with this heater during four-hour tests were felt adequate for providing a reasonably accurate basis for comparison with the results of tests with the other heaters.

Calorimeter Room

Fig. 1 is a cutaway view of the calorimeter room in which these tests were conducted. The room is not a calorimeter room in the sense of adiabatic calorimeters, but was designed to permit determination of heat flow through the walls which were of light-enough construction not to offer large heat capacity, thus minimizing fly-wheel effects with change in output.

Sheets of ½-in. insulating board are attached to the simple stud and joist framework shown, which gives a floor area of 12 × 12 ft square and a ceiling height of 8 ft. Differential thermocouples are provided to indicate the average temperature difference between the inside and outside of the wall and ceiling boards. Two blowers are mounted on the roof to force air into and withdraw air from the room through suitable ducts. Dampers at the blower inlets are provided to maintain atmospheric pressure within the room very closely. Each of the ducts has a constricted section into which is placed a pitot tube to measure the rate of flow of air and a thermocouple grid to measure the temperature of the air. The floor is highly insulated and is not provided with thermocouples.

The principal unknown in regard to the measurement of any heat liberated within the room was the value of the overall heat conductivity of the materials forming the walls and ceiling of the room. This was determined by calibration tests for which an electric heater was used to insure that the heat output would be equal to the equivalent electric input. From these preliminary tests, the overall heat conductivity was obtained by subtracting from the heat input the measured heat in the circulated room air, and dividing the remainder by the measured temperature difference across walls and ceiling.

The room was provided with all the facilities for running burning tests of heaters from which heat losses in the flue gases and in the refuse could be directly determined. Knowledge of the heat input from the weight of coal burned and of the output as given by the room data thus made it possible to evaluate the unaccountable heat losses due to tar and soot in the flue gases.

Description of Heaters Tested

Fig. 2 is a schematic diagram typical of *magazine-type*, deep-fire-pot heaters. These heaters consist of a cylindrical steel shell, lined with special refractory shapes above the grate, and capped with a casting which usually also holds the firing door and the flue collar. Primary air passes through the grates, and gases may leave the fuel bed at various heights through side channels or ducts in the refractory or may leave at the top of the bed, the type of flow depending on the extent of caking in the fuel bed. Overfire air is admitted through slots in the firing door, or slightly below it, to promote secondary burning.

The two deep-fire-pot heaters used in the tests, and designated in this paper as Heater "A" and Heater "B", were selected on the basis of being both similar and yet different in the detail arrangement of the refractory linings; there was thus an opportunity to evaluate the influence of liner configuration on heater performance. There has been constantly the hope among designers of deep-fire-pot heaters that an improved design of liner would some day be developed that, through some novel change in the flow of air and gases in the heater, would insure dependable control of heater output and reasonably smokeless operation.

Fig. 3 is a sketch of the crossfeed type smokeless heater which utilizes alloy cast iron, steel, and refractory in its construction. Crossfeed or primary air enters the fuel bed above the grates; magazine air is admitted

at the top of the fuel charge to prevent the formation of large coke pieces and thus assure self-feeding when caking coals are burned. The products of devolatilization from the magazine and from the combustion flow downward and across before passing under a secondary-air arch; at this point, secondary air is admitted through a continuous slot for the full width of the fuel bed to complete combustion. In Fig. 3, a baffle is shown in the flue-gas passage, over the magazine roof, to bring the hot flue gases in contact with the maximum area of top heat-transfer surface before their exit to the flue pipe.

Fig. 4 represents the conventional, surface-fired heater tested. Primary air is admitted through the grates and secondary air is admitted both through firing-door slots and through a *down-blast* pipe in the dome of the combustion unit. The heater is of cast-iron construction throughout.

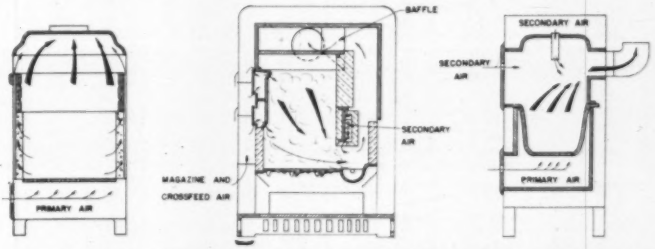


Fig. 2 (*left*)—Magazine-type heater with deep-fire pot. Fig. 3 (*center*)—Diagrammatic view of the crossfeed type smokeless heater with baffle. Fig. 4 (*right*)—Conventional surface-fired heater with two alternate forms of secondary air admission

Method of Testing Heaters

Deep-Fire-Pot Heaters

Following preliminary trials on the test stand, outside the room, to determine the time and weight of each firing to reproduce fuel-bed conditions, each of the two deep-fire-pot heaters was successively tested in the calorimeter room. In these tests, each heater was subjected to a preliminary cycle and to four test cycles; the limitations observed in the successive tests were (1) a maximum applied draft of 0.060 in. of water and (2) maintenance of flue-gas temperatures of 1300, 1100, 900, and 700 F, respectively, during the four consecutive test cycles. The upper and lower flue-gas temperatures used had been established as the practical limits obtainable under controllable conditions with these heaters during the preliminary trials on the test stand.

The fuel capacity of Heaters "A" and "B", measured from the grates to within one inch of the top of the refractory liners, was 98 and 93 lb, respectively, of 3 × 2-in. coal. When 4 to 5 in. of residual bed thickness was allowed, the refueling capacities were 75 and 70 lb, respectively. Coal from the Island Creek seam was used for all tests of Heaters "A" and "B".

The duration of each test cycle was determined by the loss-in-weight, method; the test was ended when the loss in weight was equal to the weight of fuel fired, minus the weight of ash in the fuel. Thus, tests of Heater "A" were ended when the weight loss reached 71.5 lb. Tests of Heater "B" were ended when the weight loss reached 66.5 lb.

During the period of devolatilization following the firing, the primary-air damper was closed to one-eighth open, the overfire-air damper was opened fully, and the applied draft was adjusted to maintain the imposed limitation on flue-gas temperature. As the flue-gas temperature started to drop, the primary-air damper was gradually opened wider until further opening had no effect on flue-gas temperature. Then, the applied draft was gradually increased toward the imposed limitation of 0.060 in. of water as required to maintain the flue-gas temperature limit. The grates were shaken and the bed was poked to restore any further drop in temperature. The overfire-air damper was closed at the end of the devolatilization period, that is, when smoke emission ceased.

Readings for calorimeter-room data were taken every 20 min of (1) pitot-tube total pressures, (2) pitot-tube static pressures, and (3) air temperatures, in the constricted ducts, and (4) of average voltage output of the differential thermocouples in the walls and ceiling. Readings were taken every half hour on weight loss and on applied stack draft. The barometric pressure and the wet and dry bulb temperatures were recorded every hour. Flue-gas samples were collected continuously over half-hour periods and then analyzed for CO_2, O_2, and CO. The smoke density, flue-gas temperature, and also the percentage of CO_2 in the flue gas were recorded on automatic instruments.

Smokeless Heater

Two series of tests were conducted on the smokeless heater in the calorimeter room. The first series was run with a baffle placed in the flue-gas passage. Following a preliminary cycle, the heater was subjected to three test cycles; the limitations observed were a maximum applied draft of 0.060 in. of water, and maintenance of flue-gas temperatures of 900, 775, and 650 F, respectively. The second series of tests was run immediately following, with the baffle removed, but under the same limitations as for the first series.

As in the tests of the deep-fire-pot heaters, the duration of each test cycle was determined by the loss-in-weight method, and 3 × 2-in. Island Creek coal was used as the test fuel. Since the refueling charge of the smokelss heater was set at 50 lb, each test cycle was ended at a weight loss of 47.5 lb.

The applied draft was varied between the maximum of 0.060 in. of water and a minimum of 0.020 in. of water to maintain the flue-gas-temperature limitation. Further reduction of the flue-gas temperature was obtained by closing the air-control dampers. The grates were shaken and the fuel bed was poked as often as

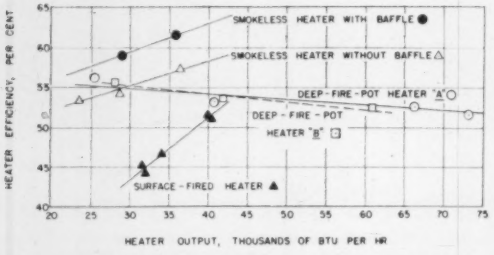


Fig. 5—Relation between heater output and heater efficiency for two deep-fire-pot heaters, a surface-fired heater, and the crossfeed type smokeless heater, when burning bituminous coal

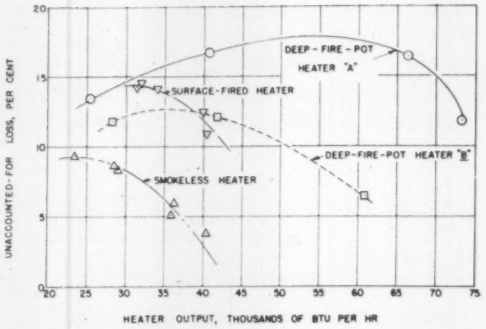


Fig. 7—Unaccounted-for losses due to soot and unburned hydrocarbons in the flue gas when burning bituminous coal in space heaters

was necessary to maintain the temperature prescribed. Readings taken were the same as those taken in the tests of the deep-fire-pot heaters described previously.

Conventional Surface-Fired Heater

The imposed limitations for each test of the surface-fired heater were that the flue-gas temperature would not exceed 900 F and that the applied stack draft would not exceed 0.060 in. of water.

Each of the tests consisted of at least three consecutive four-hour cycles. The alternate side-bank method of firing was used to minimize smoke emission. The heater was operated in such a manner as to prevent runaway operation after firing; the method used was that described previously for the deep-fire-pot heaters.

Both Illinois No. 6 and Pittsburgh coals in the 2 × 1½- and 2 × 1¼-in. size, respectively, were used as test fuels. The readings of test data taken were the same as those in the tests described previously.

Test Results

Efficiency and Unaccounted-For Losses

Fig. 5 presents the results, in graphical form, of the efficiencies obtained during tests of the four heaters in the calorimeter room. Both the surface-fired heater and the smokeless heater showed an increase in efficiency as output increased. Contrasted to these results, the two deep-fire-pot heaters showed decreasing efficiencies with increased output. It is interesting to note that the efficiency curves for the two deep-fire-pot heaters are nearly identical over the full range of outputs tested.

With respect to the smokeless heater, Fig. 5 shows that a higher efficiency of the order of 5 percent was obtained with the baffle in place as compared to the tests without the baffle.

Fig. 6 shows the relation between heater output and average flue-gas temperature for the heaters tested. At the accepted limitation of 900 F on flue-gas temperature, outputs obtained for all heaters were within the range of 40,000 to 50,000 Btu per hour. However, the outputs of the deep-fire-pot heaters were considerably higher when the upper limit on flue-gas temperature was increased beyond 900 F.

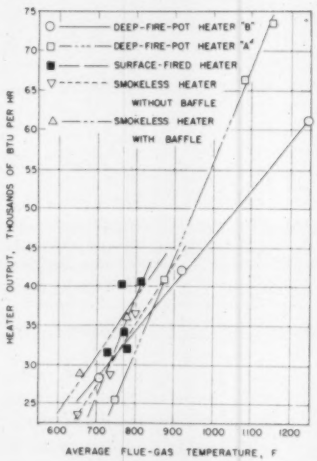


Fig. 6—Relation between heater output and average flue-gas temperature of two deep-fire-pot heaters, a surface-fired heater, and the crossfeed type smokeless heater

Fig. 7 shows the unaccounted-for losses determined from the calorimeter-room data for all of the output tests run on the four heaters. The predominating characteristic of the curves is the increase of the unaccounted-for loss to a maximum followed by a subsequent decrease as heater output increased. The unaccounted-for losses for the smokeless heater were consistently lower than for the surface-fired and deep-fire-pot heaters, and approached zero at the rating of the stove. In the range where outputs are equal, the unaccounted-for losses for the surface-fired heater and for the two deep-fire-pot heaters are of the same general order.

The initial increase and subsequent decrease of the unaccounted-for loss, typical for all heaters, is considered to be brought about somewhat as follows: As the rate of burning is increased with accompanying increase in temperature of the fuel bed, the rate of devolatilization of the fresh charge increases, and the fraction of the tars that is not burned increases; but, finally, with further increase in rate, the temperature and the degree of turbulence increase to the point

that an increasing fraction of the tars are ignited and burned with decrease in unaccounted-for losses.

Although the efficiencies of the two deep-fire-pot heaters are nearly equal at all outputs, the unaccounted-for losses were lower in the tests of Heater "B" than for Heater "A" at the same output. The difference is believed to be the result of the increased burning of tars in Heater "B", because of the high available flue-gas temperatures at the same output. The higher flue-gas temperatures were probably the result, in turn, of the difference in refractory-liner configuration utilized by the two heaters, and, to a small extent, of the slightly smaller heat-transfer area of Heater "B". That both heaters had about the same efficiency for equal outputs resulted from the fact that the lower unaccounted-for loss of Heater "B" was offset by a correspondingly higher dry flue-gas loss.

Estimates made in the past of the unaccounted-for loss when burning high-volatile bituminous coal in space heaters have usually ranged from 15 to 20 percent of the total heat input. As shown by Fig. 7, these losses for overfeed-type heaters actually are somewhat less, even when at their maximum. In addition, the variation of the unaccounted-for loss at different burning rates for a given heater, and the extent of the differences between similar heaters, demonstrate clearly that the true output rating of a heater can only be determined by the calorimeter-room method.

Comparison of Heaters

Table 1 presents a summary of the performance of each of the four heaters. These data were obtained from the performance curves previously discussed and compare the heat balances, burning rates, flue-gas temperatures, flue-gas compositions, and durations of test at an output of 40,000 Btu per hour for the four heaters. At this output, the flue-gas temperature, for all heaters, was below the 900 F temperature usually considered as a maximum not to be exceeded.

The table shows that the smokeless heater has an efficiency of 62.3 percent with a corresponding unaccounted-for loss of 3.0 percent; the efficiency of Heater "A" was 54.0 percent with a 16.6 percent unaccounted-for loss; the efficiency of Heater "B" was 54.0 percent with a 12.3 percent unaccounted-for loss; and the efficiency of the surface-fired heater was 51.0 percent with an 11.8 percent unaccounted-for loss. It may be noted that the surface-fired heater and the deep-fire-pot heaters are about equal in regard to efficiency and unaccounted-for loss, respectively.

Table 1—Comparison of Heaters at 40,000 Btu Per Hour Output

Heater	Smokeless with baffle	Deep-fire-pot heaters		Surface-fired
		"A"	"B"	
Coal	Island Creek	Island Creek	Island Creek	Pittsburgh
Size, in.	3 × 2	3 × 2	3 × 2	2 × 1-¼
Calorific value, Btu per lb	14,180	14,190	14,190	13,970
Average burning rate, lb per hr	4.50	5.22	5.22	5.63
Duration, hr	11.4	14.1	13.3	4.0
Average flue-gas temperature, F	820	870	895	810
Average flue-gas composition, percent				
CO_2	8.6	9.8	9.1	7.4
O_2	11.5	9.0	9.8	9.8
CO	0.0	0.0	0.0	0.0
Smoke emission, Ringelmann No., minutes[a]				
Above No. 1	0	390	400	21
Above No. 2	0	250	176	18
Above No. 3	0	200	75	16
Above No. 4	0	65	20	12
Heat balance, percent				
Losses:				
Steam	4.6	4.7	4.7	4.7
Dry flue gas	27.6	24.1	27.3	29.7
CO	0.0	0.0	0.0	0.0
Ashpit	2.0	0.6	1.7	2.8
Unaccounted for	3.0	16.6	12.3	11.8
Heat utilized (efficiency)	62.8	54.0	54.0	51.0
Total	100.0	100.0	100.0	100.0

[a]Data taken from actual records of test cycle of each heater approaching most nearly the 40,000 Btu per hour nominal output.

In addition to data on efficiency and unaccounted-for loss, the preliminary and room tests conducted during the course of this program provided an opportunity to compare all three types of heaters under similar operating conditions. The generally accepted merits and deficiencies of each type were well substantiated.

Control of the deep-fire-pot units in the room tests was difficult and was accomplished only by frequently adjusting the primary-air damper and the stack draft. A positive pressure in the stack was needed, at times, to obtain low and medium rates of burning; since users will not tolerate gassing from the units under these conditions, the result is that a certain amount of overheating can be expected with these heaters. Attention to the fuel bed, either by shaking the grates or by poking the bed, was required three or four times during the latter portion of a cycle to maintain the desired rate of burning with caking coals. Table 1 shows that smoke emission was considerable.

The deep-fire-pot-type heaters do, however, have their advantages. Their large fuel capacity permits an appreciable lengthening of the interval between firings, as compared with that obtainable from the surface-fired heater. Also, the higher thermal head generated within the fuel bed promotes rapid pickup and substantial heat output under what might normally be adverse chimney conditions.

The disadvantages of the surface-fired heater are essentially the same as those of the deep-fire-pot heaters, but on a smaller scale. Thus, there is only mild runaway operation, owing to the smaller weight of fuel fired, and thinner bed of fuel. Attention to the fuel bed is required only at the end of each cycle; the duration of each cycle at rating is four hours which compares unfavorably with the deep-pot units. Smoke emission on the same time basis as for the deep-fire-pot heaters is of the same order of intensity for smoke densities of No. 3 or higher.

The tests of the smokeless heater showed longer periods between firings

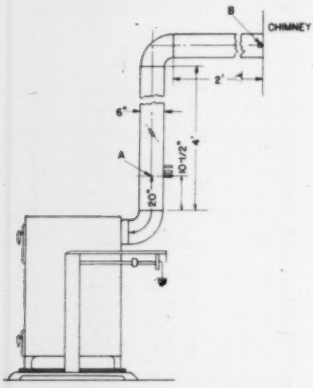


Fig. 8—Test setup of a typical coal-fired heater installation

than are obtained with the surface-fired heater, but these periods are slightly shorter than those obtained with the deep-fire-pot heaters. There is no runaway operation with the smokeless heater, because of the use of a stack-temperature limit control. Output is relatively constant and control of the output, whenever required, is easily obtained by adjustment of the stack draft and slight adjustment of the primary-air damper. Attention given the fuel bed, either by shaking the grates or by poking the bed, was required only once during each test cycle. In addition, efficiency is high and there is negligible smoke emission.

The main disadvantage in the operation of the smokeless heater is its relatively slow pickup, after firing on a cool residual bed. The duration of time required to reach rating varies; the higher the rate at which the residual fuel bed is burning, the quicker rating is reached. This disadvantage is compensated for, under ordinary heating conditions, since the stable output and long attention periods of the smokeless heater will keep the space being heated at a comfortable temperature without the necessity of quick pickup.

Heat Gain From Flue Pipe

The efficiencies shown in Table 1 are based on a flue-gas temperature which is measured 20 in. from the flue collar of the heater along the centerline of the stack. However, in most heater installations, useful heat is also supplied from the remainder of the flue pipe connecting the heater to the chimney, and, to some extent, from the chimney itself. This factor is taken into account in designing coal heaters. The furnace pipe not only vents the gases, but, for over 100 years, has been the lowest cost, simplest, and most effective heat exchanger that has been conceived for the purpose. Because of a higher temperature, the flue pipe on a coal heater is a more important heating surface than flues for other fuels, notably gas.

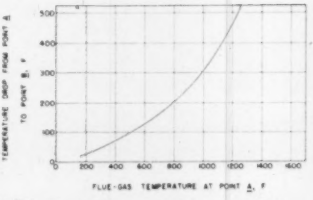


Fig. 9—Relation of temperature drop from Point A to Point B to flue-gas temperature at Point A for a typical heater installation

A series of tests was, therefore, run with the aim of determining the amount of useful heat supplied from a typical arrangement of flue pipe.

Test Setup and Procedure

Fig. 8 shows the arrangement used for experimental work on a flue-pipe setup which is typical of many coal-fired-heater installations. To measure the heat given off by the pipe, aspirating-type thermocouples were placed at Point A, 20 in. above the flue collar, and at Point B, the entrance to the chimney, to measure the temperature drop of the flue gases from the smokeless heater. In this setup a 6-in.-diameter, black stove pipe was used. Tests were run at high, medium, and low rates of burning.

Test Results

Fig. 9 is a plot showing the results of the tests to determine the relation between the drop in temperature from Point A, of Fig. 8, to the entrance to the chimney and the flue-gas temperature at Point A.

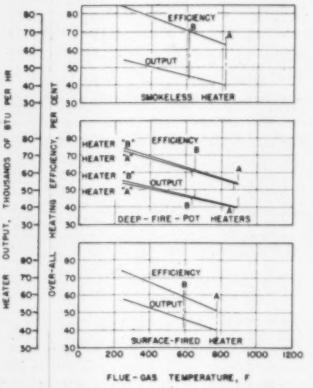


Fig. 10—Relation of output and overall heating efficiency to flue-gas temperature for the typical installation of coal-fired heaters operating at a nominal output of 40,000 Btu per hour

These data are, in the strict sense, applicable only to the particular type of heater used when operating under similar test conditions. However, the data are believed to be very nearly those that would be obtained with other types of equipment operating at the same burning rates.

Overall House-Heating Efficiency

An overall house-heating efficiency, higher than the nominal efficiency, can be calculated for heaters when the obvious contribution from heat lost by radiation from the flue pipe is taken into account, and also when it can be assumed that heat from the chimney will find its way into the dwelling.

Fig. 10, which can be used for the determination of the overall house-heating efficiency, is a plot showing the relation of output and overall heating efficiency to flue-gas temperature for the typical installation of a coal-fired heater shown in Fig. 8. Points A and B on the graph are the corresponding flue-gas temperatures at Points A and B in Fig. 8.

Fig. 10 shows that, when the smokeless heater is operating at a

nominal output of 40,000 Btu per hour, with an efficiency of 62.8 percent, the flue-gas temperature at Point A is 820 F. The temperature at Point B, where the gases enter the chimney is, however, 610 F, a drop of 210 deg. Thus, the room has gained an additional amount of heat which corresponds to this drop in temperature, an amount equal to 5000 Btu per hour. This represents an increase in output of useful heat from the heater to 45,000 Btu per hour and an increase in efficiency to 70.4 percent. Similarly, the output of Heater "A" would be increased to 45,200 Btu per hour with an efficiency of 61.0 percent; the output of Heater "B" would be increased to 45,600 Btu per hour with an efficiency of 61.8 percent; and the output of the surface-fired heater would be increased to 46,300 Btu per hour with an efficiency of 59.2 percent.

If all the heat given up by the flue gases, as they pass on up the chimney, is considered useful, the total heat utilized and corresponding overall house-heating efficiency can be obtained from Fig. 10, by determining the flue-gas temperature at the house-roof line, and reading directly from the curves the output and efficiency corresponding to this temperature value.

Since the data given in Fig. 10 are based on heater outputs at or near the maximum rating of the heaters, efficiencies for overall house-heating taken from the figure cannot be construed as being representative of the seasonal efficiency that would be obtained; also, intangible factors such as operator skill are not taken into account. The data are applicable for heating-system design purposes, however, because heating-load calculations are based upon the extreme temperature conditions expected, and the heaters would be operating at high-output rates under such conditions.

Acknowledgment

Acknowledgment is made of the contributions and suggestions of Elmer R. Kaiser, assistant director of research, and James R. Garvey, development engineer, Bituminous Coal Research, Inc.; of the work of Paul Vyff, former research engineer at Battelle Memorial Institute, in the development of the calorimeter room; and of the contributions of Charles W. Porterfield, research engineer at Battelle Memorial Institute, to the work on heat gain from a flue pipe.

Acknowledgment is also made to H. J. Rose, vice president and director of research, Bituminous Coal Research, Inc., and to the Hand-Fired Heating Equipment Committee of the Technical Advisory Board of Bituminous Coal Research, Inc., for their interest and support of the program.

PROF. "BILL" MILLER'S PORTRAIT DINNER

A portrait dinner was tendered to Prof. Bill Miller of the School of Mechanical Engineering, Purdue University, Lafayette, Ind., at the Memorial Union Building of the University on November 27, at which his portrait was formally presented to the University for hanging in its famous Hall of Fame. Professor Miller's portrait was painted by Miss Marie Goth, noted Indiana portrait painter, as a token of esteem of Professor Miller's friends, not only on the campus, but from over the state and country.

The portrait idea was originated by the officials of the *Indiana Sheet Metal and Warm Air Heating Contractors' Association*, with whom Professor Miller has worked so closely for many years as professor of heating and ventilating engineering.

Frank E. Anderson, Terre Haute, secretary of the organization sponsoring the portrait, served as treasurer and explained that funds were solicited unknown to Professor Miller and were received from scores of former students, faculty members, and men in industry.

The toastmaster at the dinner was Dr. George E. Davis and Rev. J. Dayton McCormick gave the invocation. The dinner was followed by the presentation of special guests and the portrait committee. After the Purdue Glee Club rendered a number of selections, the portrait was presented by Prof. Merle M. McClure of Purdue to Dr. Frederick L. Hovde, who accepted the portrait on behalf of the University.

WOLFF AND MUNIER ANNOUNCE NEW OFFICERS

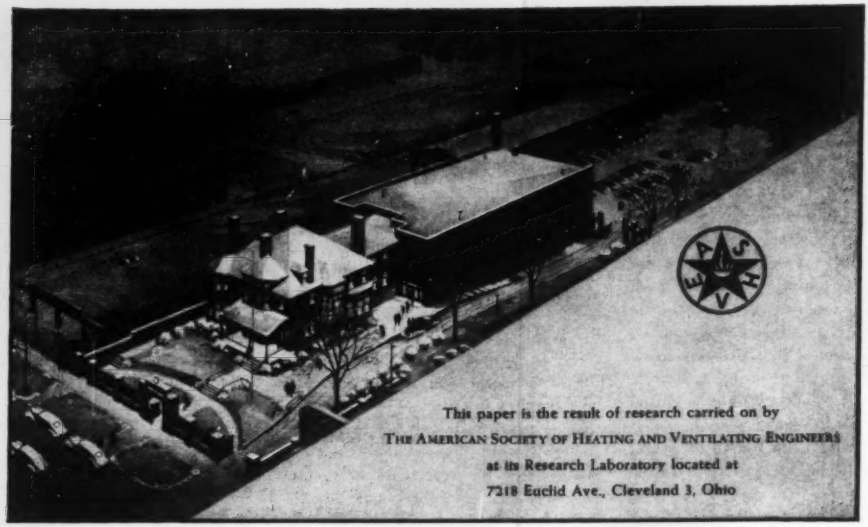
Richard A. Wolff, secretary of Wolff & Munier, Inc., New York, N. Y., has announced the recent appointment of P. B. Gordon, member of the Society's Guide Committee and formerly treasurer of Wolff and Munier, as vice president and Emile H. Munier as treasurer of that company.

D. S. STERNER JOINS GENERAL CONTROLS

J. F. Ray, vice president in charge of sales of the General Controls Co., Glendale, Calif., has announced the appointment of Douglas S. Sterner as manager of the refrigeration controls division. Mr. Sterner will make his headquarters in Chicago.

After graduation from Ohio State University with a degree in mechanical engineering, Mr. Sterner joined the Frigidaire Div., General Motors Corp., in Dayton, Ohio. He then went to the Tennessee Public Service Co., in Knoxville, Tenn., where he was employed as an air conditioning specialist. After a period of employment with the Minneapolis-Honeywell Regulator Co., he became associated with Barber-Colman Co. In 1941 he entered the U.S. Army and spent five years in the service in several foreign countries supervising the engineering and construction of cold storage facilities and other refrigeration systems. Since the war Mr. Sterner was employed with the York Corp. until his recent appointment.

Mr. Ray also announced the appointment of Richard H. Weber as manager of the newly opened factory branch sales office in Indianapolis, which will cover the territory formerly serviced by the company's Chicago and St. Louis offices.


This paper is the result of research carried on by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
7218 Euclid Ave., Cleveland 3, Ohio

Solar Energy Transmittance of Figured Rolled Glass

By George V. Parmelee* and Warren W. Aubele**, Cleveland, Ohio

SUMMARY—Solar energy transmittance data have been presented for seven patterns of figured glass. These data are of practical use in calculating solar heat gain and will be used in the preparation of design heat flow data.

It was found that even simple patterns greatly reduced transmittances, particularly at the higher angles of incidence, as compared to polished sheets of similar composition. Etching for reducing glare further reduces transmittance.

A CONTINUING program of research to develop design heat flow data for glass in its various architectural forms has been carried on since 1941 at the ASHVE Research Laboratory under the direction of the Committee on Research and the Technical Advisory Committee on Heat Flow Through Glass†. Previous papers[1,2,3] have given solar energy transmittance data for flat glass and glass block. This paper presents similar data for seven patterns of figured or patterned glass. These data will be used in the preparation of design heat flow tables like those recently published for flat glass and glass block[4].

Experimental Procedure

The Calorimeter

Except for minor changes, the calorimeter used in these studies and the instrumentation were essentially as described in the previous reports. In addition to the usual measurements of solar intensity, measurements were made, in most tests, of the low temperature radiant energy received from outdoor surroundings by the glass surface. A specially constructed convection-compensated radiometer was used for this purpose.

Table 1—Description of Figured Glass Patterns

No.		In.
11	Hammered heat absorbing glass	1/4
12	Hammered and etched heat absorbing glass	1/4
15	Ribbed flint glass (shallow ribs)	7/32
16	Ribbed flint glass (deep ribs)	7/32
17	Diffusing flint glass (small circular indentations)	7/32
20	Hammered flint glass	7/32
21	Hammered and etched flint glass	7/32

The Test Specimens

Single sheets of patterned glass, as described in Table 1, were studied in this investigation. The patterns of samples 11, 12, 17, 20 and 21 were sufficiently random in orientation that the influence of solar azimuth on transmittance at a given solar altitude was considered negligible Test results bore this out. On the other hand, samples 15 and 16 were ribbed so that the transmittances of these sheets could not be defined in terms of incident angle alone. These sheets were set in the calorimeter frame with the ribs vertical and tests were run in such a way as to bring the sun's rays parallel, at 45 deg, or at 90 deg to the direction of the ribs. In all cases the patterned surfaces were on the weather side with the rough rolled surface facing the calorimeter shell.

As in the experimental work on glass previously reported, glass surface temperatures were measured with

*Research Associate, ASHVE Research Laboratory. Member of ASHVE.

**Research Engineer, ASHVE Research Laboratory.

†Personnel: R. A. Miller, *Chairman;* A. B. Algren, W. J. Arner, A. H. Baker, F. L. Bishop, Jr., R. D. Blum, J. E. Frazier, J. S. Herbert, E. R. Koppel, D. R. Muir, F. W. Preston, W. C. Randall, C. A. Richardson, Vic Sanders, H. B. Vincent.

‡Exponent numerals refer to References.

Presented at the 57th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Philadelphia, Pa., January 1951

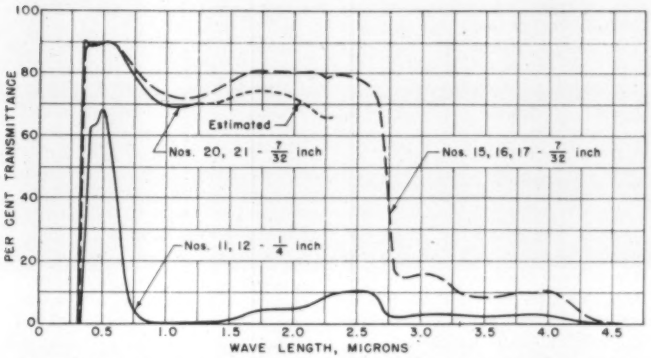


Fig. 1—Spectral transmittance curves of flat polished specimens of glass identical in composition with figured glasses studied

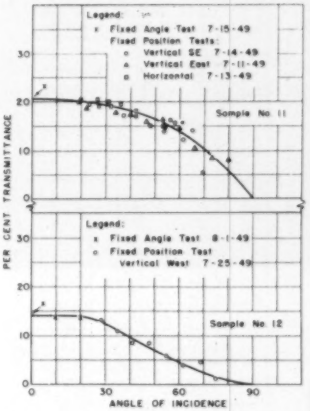


Fig. 2—Transmittance of direct solar radiation by samples Nos. 11 and 12

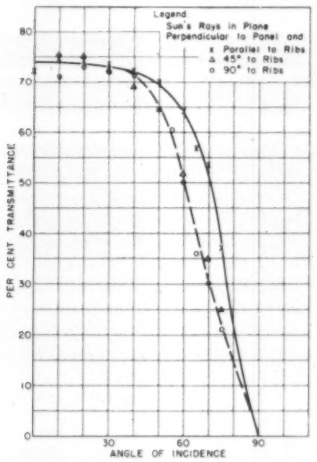


Fig. 3—Transmittance of direct solar radiation by sample No. 15

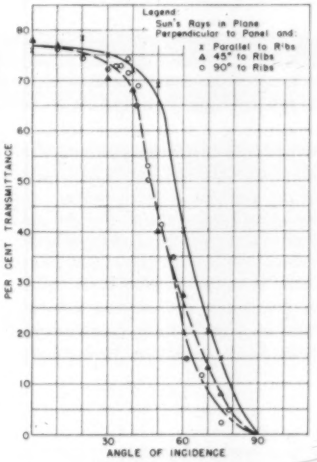


Fig. 4—Transmittance of direct solar radiation by sample No. 16

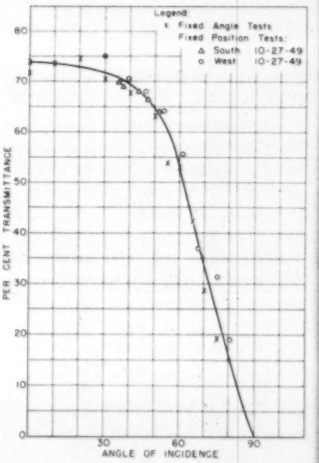


Fig. 5—Transmittance of direct solar radiation by sample No. 17

thermocouples cemented into shallow grooves with Canada balsam cement.

Results Obtained

Spectral Transmittance Characteristics

Flat polished specimens taken from the same sheets as those studied in the calorimeter were examined to determine their spectral transmittance characteristics; the results are shown in Fig. 1. Values for flint glass have been corrected to 7/32 in. thickness and those for heat absorbing glass have been corrected to ¼ in., since these are the nominal thickness of the samples listed in Table 1. Table 2 compares the normal incidence transmittance values for these specimens computed for Moon's[5] energy distribution for air mass = 2 with transmittance tests made on small flat polished specimens in direct sunlight.

Transmittance of Solar Radiation

Transmittance values for diffuse solar radiation as determined by calorimeter tests are given in Table 3. In addition to giving the range of values determined and the average of the various tests, the table also gives computed values and values recommended for design use. The computed values were determined by integration over a quarter sphere of the product of the energy received at a given incident angle times the transmittance of the glass for direct solar radiation at that angle of incidence. It was assumed that the sky vault was a uniform radiant energy source. The design values are those which gave the least scatter of test points

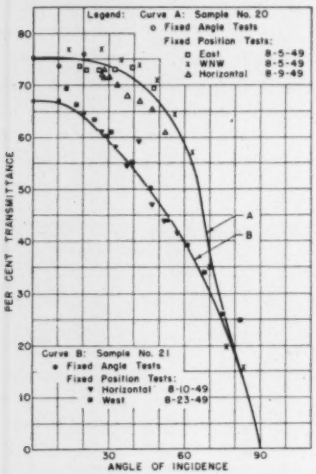


Fig. 6—Transmittance of direct solar radiation by samples Nos. 20 and 21

when transmittance of direct radiation was plotted against incident angle.

Transmittance values for direct solar radiation as a function of incident angle are given in Figs. 2 through 6. As noted on the figures, test points for samples 11, 12, 17, 20 and 21 include data from both fixed incident angle tests and fixed orientation tests. The agreement between the test points and the curves indicates that these patterns had no special orientation. Hence, the transmittance curves are functions of incident angle only. The curves for samples 15 and 16 show, however, that the transmittance will vary with different combinations of solar altitude and azimuth angles that give the same incident angle.

Total Heat Gain from Sunlit Glass

In most practical cases in the field of air conditioning, glass is opaque to all radiation except that from the sun or from lighting installations. This is illustrated by the spectral transmittance curves of Fig. 1 which show that the transmittance is practically zero for wavelengths of 4.5 μ (microns) or longer. Even from radiant energy sources at temperatures as high as 450 F only a negligible amount, approximately 2 per-

Table 2—Transmittance Values of Flat Polished Specimens of Figured Glass for Normally Incident Direct Solar Radiation

	Tests in Sunlight with the Smithsonian Silver Disk Pyrheliometer					Calculated for Standard Energy Distribution[a]	
	As Tested			Corrected Values			
Sample No.	Thickness In.	Range in Trans. %	No. of Tests	Thickness In.	Av. Trans. %	Thickness In.	Trans. %
11, 12	0.197	26.1-27.9	2	1/4	19.5	1/4	24.1
15, 16, 17	0.159	79.8-80.7	2	7/32	76.4	7/32	82.0
20, 21	0.190	77.1-80.6	3	7/32	77.1	7/32	80.3[b]

[a]Moon's[5] energy distribution for air mass = 2.
[b]Spectral values > 1.25 μ estimated.

cent, is transmitted by glass. If lighting sources can be neglected it is convenient to express the heat flow through a glass section by the following heat balance equation in which the heat flow quantities are for a unit area and a unit time:

$$\left[\begin{array}{l}\text{Total heat flow}\\ \text{through glass}\\ \text{section}\end{array}\right] = \left[\begin{array}{l}\text{Transmitted}\\ \text{solar radiation}\end{array}\right] \pm \left[\begin{array}{l}\text{Heat flow by convective}\\ \text{and radiative exchanges}\\ \text{at the indoor surface}\end{array}\right] \quad \ldots\ldots(1)$$

The data on transmittance just presented show that the transmitted solar radiation is dependent upon the glass properties and the nature and angle of the incident solar radiation. On the other hand, the heat flow by convective and radiative exchanges at the indoor surface is dependent upon these same factors plus the influence of the indoor and outdoor environments. This heat flow can be expressed by a second heat balance equation as follows:

$$\left[\begin{array}{l}\text{Heat flow by convective}\\ \text{and radiative exchanges}\\ \text{at the indoor surface}\end{array}\right] = \left[\begin{array}{l}\text{Absorbed}\\ \text{solar}\\ \text{radiation}\end{array}\right] \pm \left[\begin{array}{l}\text{Radiative exchanges}\\ \text{between outer sur-}\\ \text{face of glass and}\\ \text{outdoor surroundings}\end{array}\right] \pm \left[\begin{array}{l}\text{Convective exchanges}\\ \text{between outer surface}\\ \text{of glass and outdoor}\\ \text{air}\end{array}\right] \pm \left[\begin{array}{l}\text{Heat storage}\\ \text{within the}\\ \text{glass section}\end{array}\right] \quad \ldots\ldots(2)$$

Fig. 7 illustrates Equations 1 and 2 by giving instantaneous rates of heat gain for a west-oriented vertical sheet of glass No. 21. Total heat gain and the convection and radiation heat flow from glass to calorimeter as determined by test have been corrected to a zero differential temperature between the outdoor air and the calorimeter surface. The gain due to transmitted solar radiation is the difference between the two heat gain curves.

Discussion of Results

Solar Energy Transmission

Table 2 shows that the normal incidence transmittance of polished samples is subject to some variation. This is due primarily to differences in the energy distribution of the incident rays caused by day-to-day and hour-to-hour changes in the thickness and composition of the atmosphere in the sun's path. These variations are somewhat smaller than have been observed in tests on other samples because of the smaller number of tests made.

Fig. 8 is presented in order to show the effect of pattern or surface treatment on transmittance. The figure shows transmittance as a function of incident angle for flat polished sheets of the same overall thickness as the patterned sheets. The curves were computed for an energy distribution according to Moon's[5] suggested standard for air mass of two. Comparison of Fig. 8 with Figs. 2 through 6 shows that even the simplest patterns significantly reduce transmittance. The effect of etching to produce glare reducing surfaces is even more marked.

Because the transmittance of the ribbed glasses, Nos. 15 and 16, can-

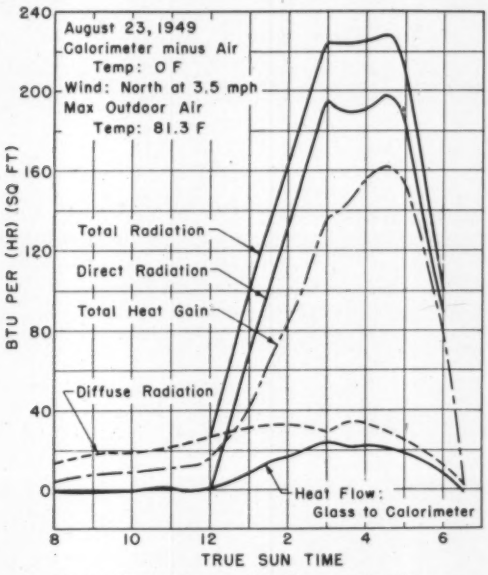


Fig. 7— Test results for glass No. 21, oriented west

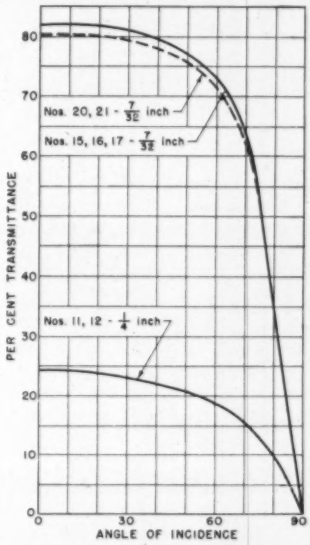


Fig. 8—Computed transmittances of flat polished samples of glass identical in composition with figured glasses studied

not be given in terms of incident angle only, two sets of iso-transmittance curves are presented in Figs. 9 and 10. These give transmittance as a function of altitude and azimuth for both vertical and horizontal sheets. If the glass is installed with ribs vertical in a vertical wall, the azimuth angle is the angle between the projection of the sun's rays on a horizontal plane and a line perpendicular to the wall. For horizontal sheets, azimuth is measured with respect to the direction line of the ribs. Solar altitude is, of course, the angle of the sun above the horizon.

Table 3 shows that the transmittance of a glass sheet for diffuse solar radiation may vary widely (the experimental error in the determination of solar gain is of the order of 3 to 5 percent). There is considerable evidence to show that much of this is probably due to the effects of angular distribution of the incident diffuse radiation.

In order to study the magnitude of this effect, diffuse transmittance tests were made with a 2-ft sq sheet of high transmission glass. Use of this type of glass eliminated the possible influence of energy distribution. The tests were made by placing the glass over the pyrheliometer, observing the emf, and then observing the emf when the glass was removed. The pyrheliometer was shaded from the direct sun at all times by a 3-in. diameter disk about 30 in. away from the instrument.

Table 3—Percent Transmittance of Configurated Glass For Diffuse Solar Radiation

Sample No.	By Calorimeter Tests		Calculated	Design Values
	Range	Av.		
11	20.2-25.5	22.4	16.0	20.0
12	12.6-23.6	18.0	8.2	16.0
15	51.2-74.0	60.0	61.6	60.0
16	41.2-58.5	47.9	51.3	48.0
17	49.9-69.8	59.0	59.0	59.0
20	62.6-71.7	67.1	62.9	63.0
21	45.6-59.4	48.3	48.4	48.0

The investigation showed that the diffuse transmittance varied with the incident angle, being greatest at normal incidence and dropping as the angle was reduced. There was about 8 percent difference between the lowest and highest values. This can be accounted for by the fact that much of the diffuse radiation comes from the near vicinity of the sun and hence is transmitted in accordance with the incident angle. One would therefore expect the transmittance to vary also with the ratio of direct to diffuse radiation.

The lack of uniformity in the angular distribution of diffuse solar energy is further illustrated by observations of the variation in the diffuse irradiation of vertical and horizontal surfaces with altitude and azimuth. For the same solar altitude it was found that the ratio of diffuse radiation falling on a vertical plane to that on a horizontal varied from about 0.5 with the sun 180 deg away from the wall to as much as 1.4 when the sun's azimuth with respect to the wall was zero. If the diffuse radiation of all points of the sky was of equal intensity, this ratio would be 0.5.

On the average the diffuse transmittances were closely equal to those computed from direct transmittance data and to those found to give the best fit of data. The latter are recommended for design purposes. Two exceptions, the values for heat absorbing glass, were expected. In this case the energy distribution is

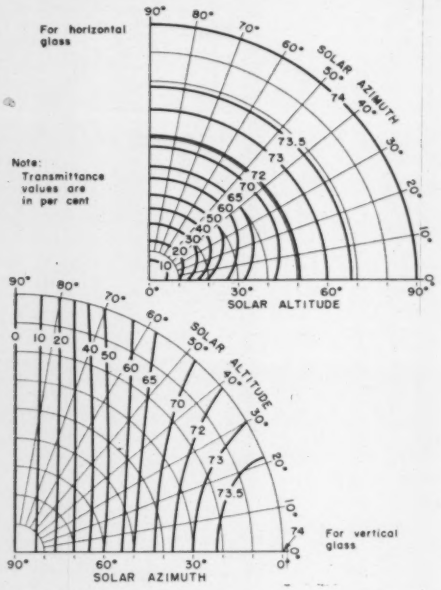


Fig. 9—Direct solar radiation iso—transmittance curves for sample No. 15

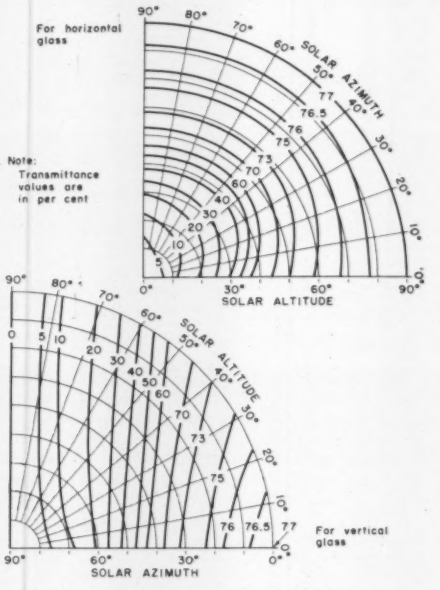


Fig. 10—Direct solar radiation iso—transmittance curves for sample No. 16

responsible. Diffuse solar radiation is deficient in infrared energy as compared to that from direct sun; therefore, heat absorbing glass which has a low infrared transmittance will give higher diffuse transmittances than would be predicted from the direct radiation transmittances.

Total Heat Gain

The heat flow data given in Fig. 7 are not to be construed as design data, but simply represent heat flow under the test conditions noted on the figure. The design of the calorimeter is such that instantaneous heat flow rates are instantaneous cooling loads. In most practical cases of air conditioning, much of the transmitted radiation is absorbed by the interior structure and is gradually released to the room air. The resulting apparatus load therefore lags behind periodic instantaneous heat gain and has a reduced amplitude.

The fact that there is considerable radiation and convection gain by the calorimeter from the glass is due to absorption of solar energy. During the morning hours the absorbed solar radiation was very nearly balanced by radiation loss to the outdoor surroundings. This gain was, of course, greater for glasses Nos. 11 and 12 because of their greater absorption.

It is of interest to note that the solar radiation data presented in Fig. 7 very closely approximate the values suggested for a clear atmosphere in a recent research paper[4]. Some departure from the design values occurs in the late afternoon because sunset on August 23 occurs about ½ hour earlier than on an August 1 design day. Typical of Cleveland, the maximum dry bulb, 81 F, and dew-point, 60 F, associated with these solar intensities are much below the usual design values of 95 F and 67 F respectively.

Acknowledgment

The authors acknowledge with thanks the suggestions and assistance given by members of the Technical Advisory Committee on Heat Flow Through Glass and by their colleagues of the ASHVE Research Laboratory staff during the course of the work described in this report.

References

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2. ASHVE Research Report No. 1348—Solar and Total Heat Gain Through Double Flat Glass, by G. V. Parmelee and W. W. Aubele (ASHVE Transactions, Vol. 54, 1948).

3. ASHVE Research Report—Solar Energy Transmittance of Eight-Inch Hollow Glass Block, by G. V. Parmelee and W. W. Aubele (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, September 1949, p. 111).

4. ASHVE Research Report—Heat Flow Through Unshaded Glass: Design Data for Use in Load Calculations, by G. V. Parmelee and W. W. Aubele (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, June 1950, p. 123).

5. Proposed Standard Solar Radiation Curves for Engineering Use, by Parry Moon (*Journal of the Franklin Institute*, Vol. 230, 1940, p. 583).

Samuel R. Lewis to Receive F. Paul Anderson Medal

AT THE 57th Annual Banquet of the Society on January 24 at the Bellevue-Stratford, it was announced by Pres. Lester T. Avery that Samuel R. Lewis was voted the F. Paul Anderson Medal for 1950 in recognition of his outstanding contributions to the advancement of heating, ventilating and air conditioning. Presentation of the medal will be arranged when Mr. Lewis returns to this country. He is the ninth member to be selected for the award by the Council of the Society from nominations submitted by the F. Paul Anderson Committee. Previous recipients have been the late Dr. Willis H. Carrier, Dr. A. C. Willard, Prof. Frank B. Rowley, Dr. F. E. Giesecke, the late Dr. Ferry C. Houghten, Alfred E. Stacey, Jr., the late James H. Walker and Dr. C.-E. A. Winslow. The award was established in 1930 by the late Thornton Lewis of Philadelphia, who was president of the Society in 1929, and is presented to ASHVE members in recognition of notable scientific achievement or outstanding services in the heating, ventilating and air conditioning field.

Samuel R. Lewis
Chicago, Ill.

Inspiration to Profession

The Committee felt that Mr. Lewis was eminently fitted to receive this medal, which is given "in recognition of notable scientific achievement or outstanding services performed in the field of heating, ventilating, or air conditioning". He exemplifies the best that the ASHVE stands for —engineering skill, advancement of the profession through laboratory and field research, professional ethics, inspirational help to younger members, and a complete frankness in sharing his experience and knowledge for the benefit of the profession.

Mr. Lewis was born in Ottawa, Ill., July 14, 1878. He was graduated from Ottawa High School in 1894 and continued his education in the International Correspondence Schools for which he was later to write texts in heating, ventilating and air conditioning which have been recognized as basic in their field.

Responsible for the first use of a number of advanced methods which have since become accepted practice in the field, Mr. Lewis is the author of "Air Conditioning for Comfort," one of the first textbooks on the subject, published in 1932, which has been widely used both by practicing engineers and in schools. Other texts of his are "Railway Air Conditioning," "Heating, Ventilating and Air Conditioning," "Piping for Seagoing Vessels," "Plumbing," and "Air Conditioning and Refrigeration," written in collaboration with Prof. Burgess H. Jennings, chairman of the department of mechanical engineering, Northwestern University.

A Founder of First Chapter

Mr. Lewis became a member of the ASHVE in 1905. He served on the Council in 1914 and 1915 and was president of the Society in 1914. He was chairman of the Committee on Research in 1927 and 1928. Mr. Lewis was one of the founders of the Illinois Chapter, oldest of the ASHVE Chapters, in which he has held all of the various chapter offices.

He is a member of the *American Society of Refrigerating Engineers*, the *National District Heating Association*, the *Western Society of Engineers* and the *Chicago Association of Consulting Engineers*.

Members of the F. Paul Anderson Committee were Chairman, Lauren E. Seeley, president-elect of the Society, and dean of the College of Technology, University of New Hampshire, Durham, N. H.; E. O. Eastwood, past president of ASHVE, and professor of mechanical engineering, University of Washington, Seattle, Wash.; Walter L. Fleisher, past president of ASHVE, and president of Air & Refrigeration Corp., New York, N. Y.; H. Berkley Hedges, manager, Blast Coil Surface Sales, John J. Nesbitt, Inc., Philadelphia, Pa.; and G. L. Tuve, past president of ASHVE, and head, Dept. of Mechanical Engineering, Case Institute of Technology, Cleveland, Ohio.

Summary of Chapter Meetings*

• *ATLANTA*—December 11, 1950. Members and guests met at Harris Tea Room for a social hour and dinner preceding the business meeting. H. L. Baker, Jr., presiding officer, called the meeting to order and introduced the guests of the evening, 16 members of the National Certified Pipe Welding Bureau, Technical Committee, a unit of the *Heating, Piping & Air Conditioning Contractors National Association.* The reading of the minutes and committee reports was postponed in the interest of conserving time.

Mr. Everhart of the National Certified Pipe Welding Bureau outlined the Bureau's function and said that it was organized in 1940 to make a preliminary study of welding certification and procedures. The committee will shortly publish a manual which Mr. Everhart stated would prove the value of the study. He stated that a further purpose of the Bureau is the establishment of chapters throughout the country to test and/or inspect welding procedures and welds.

The nominating committee then presented its report and the following chapter officers were installed for the 1951 season: *president*—E. K. Jamison; *vice president* — J. J. O'Shea; *secretary*—G. B. Hightower; *treasurer*—John Crowley; and *board of governors*—W. M. Garrard and G. D. Guler.

The speaker of the evening, G. B. Priester, air conditioning engineer, Consolidated Gas, Electric Light & Power Co., Baltimore, Md., was introduced, and spoke on *Trends and Troubles in Air Conditioning*, presenting along with the talk copies of detailed statistical studies which were distributed to the members. At the conclusion of the talk, the meeting was turned into an open forum. Attendance 52.

• *ATLANTA*—November 13, 1950. The business meeting was called to order following a social hour and dinner at Harris Tea Room and the minutes of the October meeting were read and approved. The nominating committee presented its report.

F. A. Player introduced the speaker of the evening, J. deB. Shepard, associate of P. L. Davidson, consulting engineer, Greenville, S. C., who presented a paper entitled *Design For Controllability of Industrial Air Conditioning.* The paper brought out the complexities of design factors in accomplishing the desired purpose in application of air conditioning to textile mills. An extended discussion period followed in which questions peculiar to textile industry practices were submitted and general observations offered satisfactory answers. The meeting was adjourned at 9:30 p.m. Attendance 47.

• *CENTRAL OHIO*—December 12, 1950. The meeting was called to order by A. D. Bogen, secretary of the chapter, in the Athletic Club of Columbus at 8:00 p.m. The minutes of the November meeting were read and approved; however, due to the small attendance caused by the preholiday season, it was decided to carry over committee reports until the January meeting.

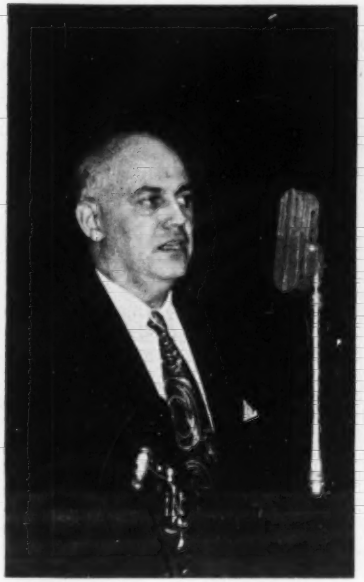
It was moved that H. G. Hays, president of the chapter, and R. S. Curl, vice president of the chapter, be appointed to serve as member and alternate member, respectively, on the Society's Chapters Conference Committee. The motion was passed. The meeting adjourned at 9:00 p.m. Attendance 12.

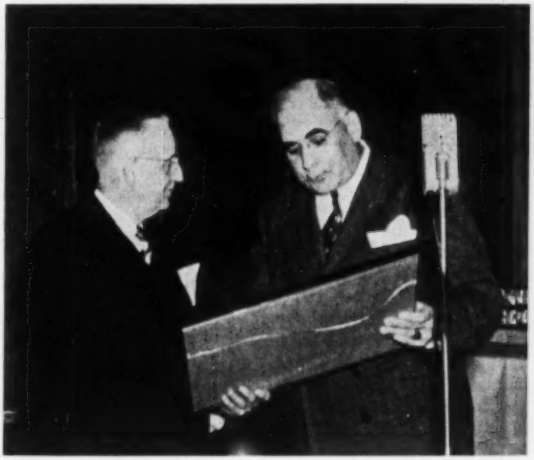
• *CENTRAL OHIO*—November 20, 1950. The meeting was called to order by Pres. H. G. Hays at 8:00 p.m. at the Hoffman Garden and the minutes of the October meeting were read and approved. This was followed by the introduction of guests and the report of the treasurer. T. E. Darby introduced the speaker of the evening, W. T. Shinholser, vice president of a local utility, who spoke on *You and the Gas Business.* His talk covered the growth and expansion of gas usage, and a review of the past and a forecast of the future.

Following Mr. Shinholser's talk, A. D. Bogen introduced Mike Peppe, head swimming coach at Ohio State University, and Tony Montenaro, assistant wrestling coach at the University, who showed pictures of sports activities at Ohio State University. Attendance 52. Attendance ratio 0.44.

• *CINCINNATI*—December 5, 1950. Pres. E. W. McNamee called the meeting to order at 7:45 p.m. in the Engineering Society Headquarters and the minutes of the November 7 meeting were read and approved. R. C. Beineke, program chairman, reported the programs for the forthcoming meetings as follows: January—joint meeting with the *ASRE*, with Dr. Clarence A. Mills as speaker; February—H. B. Silberstein showing colored movies taken in Peru and Mexico; March —panel discussion (members were asked for suggestions on the subjects to be discussed); and April—Carl F. Boester speaking on *New Practices in Forced Hot Water Heating.* R. J. Hanschen gave a report for

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.





B. K. Eaton, La Grange, Ill., *(left)* receiving Life Membership Certificate from A. L. Walters. The presentation was made at the December 11 meeting of the Illinois Chapter of ASHVE.

P. B. Gordon, New York, N. Y., speaking before Illinois Chapter members at December 11 meeting.

the membership committee and J. J. Bechtol, secretary, spoke concerning train reservations to Philadelphia for the Society's 1951 Annual Meeting.

R. G. Anderson introduced the speaker of the evening, J. N. Livermore, mechanical engineer of The Detroit Edison Co., Detroit, Mich., who spoke on *Actual vs. Predicted Cooling Loads*. Mr. Livermore cited a number of practical experiences with regard to the actual cooling load in one building as against the calculated load. At the conclusion of his talk, Mr. Livermore was given a rising vote of thanks. The meeting adjourned at 10:15 p.m. Attendance 43. Attendance ratio 0.37.

• *CONNECTICUT*—November 30, 1950. Pres. D. M. Hummel called the meeting to order in the Algonquin Club, Bridgeport, at 7:15 p.m. The reading of the minutes of the previous meeting and committee reports were dispensed with.

President Hummel introduced the speaker, A. G. H. Dietz, associate professor of structural engineering, Massachusetts Institute of Technology, Cambridge. Professor Dietz spoke on *Solar Heating for Houses* and illustrated his talk with slides showing various model houses and their adaption to solar heat collectors. The talk was well received and enjoyed by all. The meeting adjourned at 10:15 p.m. Attendance 52. Attendance ratio 0.24.

• *DELTA*—November 14, 1950. Pres. Ralph Elizardi called the meeting to order at 7:15 p.m. and following the introduction of members and guests, the minutes of the previous meeting were read and approved as read. Announcement was made of the invitation of the *ASRE* to attend its December meeting to be held at the New Orleans Athletic Club, at which James Todd, past president of *ASME*, would speak on *Engineers Joint Council and Unity of the Engineering Profession*. Several committee reports were given and a report by the treasurer. It was also announced that in connection with the annual meeting of the *Louisiana Engineering Society* to be held January 18 to 20, 1951, the Delta Chapter of the ASHVE would supply the speaker for the joint ASHVE—*ASRE* meeting. C. V. Bankston, sales mgr., Industries Sales Corp., New Orleans, will be the speaker and his subject will be *Application of Air Conditioning in Process Work*. J. S. Burke and Walter Cooke were elected member and alternate member, respectively, on the Society's Chapters Conference Committee.

President Elizardi introduced Lester T. Avery, president of the Society, who spoke briefly on Society activities, after which he discussed *Dynamic Air Conditioning*. He said that it is untrue that everyone requires a different temperature and further stated that there is a temperature that is effective for nearly everyone. Attendance 36.

• *GOLDEN GATE*—December 14, 1950. The Christmas Party was held at the Hotel Claremont in Berkeley, Calif., and after dinner dancing was enjoyed by all. No business was transacted with the exception of the presentation of the report of the nominating committee on nominees for chapter officers for the 1951 season as follows: *presi-*

dent—R. C. Cushing; *vice president*—T. J. Janes; *secretary*—T. J. White; *treasurer*—J. E. Murray; *board of governors*—F. K. Crouch, D. E. McLeod, and Eric Roberts. The meeting was attended by 94 members and guests.

• *IOWA*—November 14, 1950. Following a social hour and dinner at the Standard Club, Des Moines, Pres. R. S. Stover called the meeting to order and welcomed the members and guests. The guests were introduced by their member hosts. President Stover announced the resignation of C. P. North, chapter vice president, due to illness and reported that at the board of governors meeting, C. H. McGuiness, chapter secretary, was appointed to fill Mr. North's term as vice president and that R. H. Schnell had been appointed secretary-treasurer. The minutes of the previous meeting were read and approved.

Mr. McGuiness, program chairman, introduced the speaker, C. A. L. Davis, vice president, John H. Kitchen & Co., Kansas City, Mo., who spoke on *The Heating of Public Buildings by Means of Warm Air*. Mr. Davis touched on the history of warm air heating and told of the recent improvements. He pointed out that new designs of introducing the heated air into the rooms by using floor supply ducts and the tempering of the air for each specific area eliminated drafts and maintained even temperatures. He stated that installations of this type are running about nine and a half to twelve percent of the total cost of the buildings; and while the air is normally introduced into the room through outlets along the outside walls at the baseboard level, there are times where high outlets must be used, as in kitchens and halls. In closing he pointed out the advantages of properly zoning certain installations. Following his talk, Mr. Davis called for a question and answer period, which was followed by a round table discussion. Attendance 34.

• *KANSAS CITY*—December 4, 1950. Pres. W. E. Howarth called the meeting to order in the Roof Garden of the Aladdin Hotel, Kansas City, and the minutes of the November 6 meeting were read and approved with a slight change. C. W. Schumacher reported that the January meeting would be held January 8 and that the guest speaker would be Ferdinand Jehle, engineering consultant, Hoffman Specialty Co., Indianapolis, Ind., who would speak on *Panel Heating and Its Control*. A. R. Scott introduced 8 student member guests from the University of Kansas.

Mr. Schumacher introduced the speaker of the evening, Frank Paxton, Gas Service Co., of Kansas City, Mo., who spoke on the subject *The Gas Industry, Today and Tomorrow*. Mr. Paxton's talk covered where the gas came from, how it was delivered, how it should be handled, etc. The talk was very well presented and proved interesting and enjoyable to the members. Attendance 70. Attendance ratio 0.27.

• *MANITOBA*—November 16, 1950. President Fleming called the meeting to order at 8:00 p.m. in the Fort Garry Hotel, Winnipeg, and the minutes of the October 20 meeting were read and approved as read. President Fleming announced that a meeting of the board of governors would be held within that week for the purpose of setting up additional committees within the Chapter.

T. W. Southey introduced the speaker of the evening, F. W. Satchwill, manager gas sales, Winnipeg Electric Co., who spoke on *The Present and Future Winnipeg Power Picture*. Mr. Satchwill outlined an improved possibility of natural gas in Winnipeg but no definite time factor was mentioned. The meeting was adjourned at 9:40 p.m. Attendance 14.

• *MANITOBA*—October 20, 1950. The meeting was called to order by Pres. C. M. Fleming at 8:00 p.m. in the Fort Garry Hotel, Winnipeg, Manitoba. The minutes of the September 18 meeting were read and approved and President Fleming outlined the reasons for the increase in Chapter dues.

The speaker of the evening, J. H. Fox, commercial sales manager, Minneapolis-Honeywell Regulator Co., Ltd., Toronto, and member of the Society's Chapter Relations Committee, was introduced. Mr. Fox spoke on *Gadgets, Gimmicks and Electronics* or *Tools of the Future*. Following the talk, Mr. Fox was thanked by Mr. Davis on behalf of the Chapter for his presentation. Attendance 19.

• *MASSACHUSETTS* — November 21, 1950. Through the courtesy of the New England Telephone and Telegraph Co., the Chapter was conducted on an inspection tour of the new Long Distance Building, Boston. Following dinner in the Telephone Company's cafeteria, the group assembled in the auditorium. Carl Beck, Massachusetts mechanical plant engineer of the New England Telephone and Telegraph Co., described the building using a scale model to illustrate his talk. The building volume is 8,485,000 cu ft with 515,259 sq ft of floor space, housing 2,700 employees. All long distance calls in the New England area are routed through this building and operators are able to dial calls automatically at a great saving in time and expense.

Amos Kent, design engineer, Buerkel Co., outlined the important engineering features of the heating, ventilating and air conditioning systems for the building. The heating plant includes two water tube, 460 hp steam boilers. Both boilers are oil fired and one is equipped with a stoker and may be connected to coal firing in 36 hours.

The audience was then divided into five groups and was conducted through the building. Guides took each group to the boiler room, the compressor room, the cooling tower and typical equipment rooms. Of particular note was the ample space

provided for all mechanical equipment, the efficient arrangement of all systems, and the excellent appearance of all equipment areas.

In addition to viewing the heating and ventilating systems, the groups were shown a switchboard room where long distance calls are dialed automatically, and a dial switching apparatus room.

The tour gave the members an opportunity to personally examine the operation of one of the most extensive and modern installations of heating and air conditioning equipment in this vicinity.

All enjoyed the tour and expressed their appreciation to the New England Telephone and Telegraph Co. officials for their courtesy. Attendance 54. Attendance ratio 0.50.

• *MIAMI VALLEY*—November 13, 1950. Pres. C. D. Weaver called the meeting to order after dinner at Pappys Kitchen Cottage and introductions were called for. On request of the acting membership chairman, W. R. Budde, President Weaver appointed Dave Pickrel and F. S. Hamer to select a new membership chairman. Following the announcement of a few items concerning chapter affairs, R. C. Allen reported that S. R. Lewis, past president of ASHVE and partner, Samuel R. Lewis & Associates, Chicago, Ill., would be the guest speaker at the next meeting. Mr. Allen then introduced J. R. Vernon, assistant secretary and sales promotion mgr., Johnson Service Co., Milwaukee, Wis., who spoke on *Current Practices in Automatic Temperature Control for Heating and Air Conditioning*. Following a discussion period, the meeting was adjourned. Attendance 35.

• *MICHIGAN*—December 11, 1950. The December meeting was a joint meeting with the Detroit sections of the *ASRE* and the *ASME*, and the discussion of chapter business was waived in view of the full program. Dinner was served at 6:30 p.m. in the Engineering Society of Detroit building and T. J. Ammel, chairman of the Detroit section of *ASRE*, acted as toastmaster. H. K. Gandelot, chairman of the Detroit section of *ASME*, introduced the coffee speaker, D. A. Gauthier, French consular agent for Detroit who spoke on *Some Recent Observations in France*. Mr. Gauthier's extremely interesting presentation was based upon comparative personal observation during his visits to France in 1935 and 1950. He voiced optimism in the decrease of Communistic control, and stressed the extreme importance of the Marshall Plan and the present precarious geographical situation of France.

The members then retired to the auditorium and C. F. Donohoe, president of the Michigan Chapter of ASHVE, introduced the moderator of the evening, J. N. Livermore. Mr. Livermore then presented the following men, who participated in the program, speaking on the subjects listed: Prof. Axel Marin, University of Michigan, Ann Arbor, Mich.—Heating; Bradlee Pruden, Giffels & Vallet, Detroit, Mich.—Cooling; H. E. Ziel, Albert Kahn, Inc., Detroit, Mich.—Ventilating; T. N. Adlam, vice president and general manager, Sarco Mfg. Corp., New York, N. Y. — Panel Heating. The representative attendance and the number of questions following each presentation indicated a successful and interesting program. Attendance 250. Attendance ratio 0.33.

• *MINNESOTA*—December 4, 1950. Members and guests met in the Garden Room of the Dyckman Hotel, Minneapolis, and Pres. G. M. Kendrick called the meeting to order at 8:10 p.m. introducing the guests of the evening. A short account of the tentative arrangements for the February 23, 1951 meeting of the Minnesota Federation of Engineering Societies was given. The minutes of the November meeting were then read and approved. The chapter representative on the local Civilian Defense Committee, J. A. Holbrook, gave a report on the November 14 meeting of the Committee. His report indicated the apparent lack of interest and inadequacy of civilian defense organizations in the cities in the central part of the country.

E. F. Snyder, vice president of the Chapter, introduced the speaker of the evening, Richard Feigal, project engineer, Minneapolis-Honeywell Regulator Co., who replaced the scheduled speaker who was ill. Mr. Feigal spoke on *Electronic Humidity Control* and gave a very interesting presentation, which was followed by a question and answer period. Attendance 96. Attendance ratio 0.29.

• *NEBRASKA*—November 14, 1950. Pres. G. W. Colburn called the meeting to order at 6:30 p.m. in the Hotel Castle, Omaha. The guest speaker of the evening, W. E. Nanes, consulting engineer from Des Moines, Ia., was introduced. Mr. Nanes spoke on *Designing the Heating and Air Conditioning for a Modern Office Building*, and illustrated his talk with motion pictures. He covered the complete history of the installation of the air distribution system in the new Iowa Power & Light Company office building in Des Moines, and also gave some interesting comparative installation cost figures. The meeting was adjourned at 9:30 p.m. Attendance 30. Attendance ratio 0.25.

• *NORTH CAROLINA*—December 8, 1950. Following a social hour, dinner was served at 7:00 p.m. at the Starmount Country Club, Greensboro. At the completion of dinner, the meeting was called to order by Pres. M. F. DuChateau and a statement of chapter finances was given by G. B. Rottman, the secretary-treasurer. This was followed by the election of officers for the 1951 season with the following results: *president*—R. O. McGary; *vice president*—L. L. Vaughan; *secretary-treasurer*—J. A. Rice; *board of governors*—M. F. DuChateau, Alton Skinner, Jr., W. H. Sullivan, Jr., and R. M. Warren, Jr.

At the conclusion of the balloting, Mr. DuChateau turned the meeting

over to the new president, Mr. McGary. Mr. McGary expressed his appreciation for being selected president and asked for the continued cooperation of the membership to insure a bigger and better North Carolina Chapter.

J. E. Hart, program chairman, then introduced the speaker of the evening, R. D. Tutt, chief engineer, Tuttle and Bailey, Inc., New Britain, Conn. Mr. Tutt spoke on *Modern Trends in Air Distribution* and at the conclusion of the talk a lengthy discussion period on the subject was conducted. The meeting was adjourned at 10:30 p.m. Attendance 68. Attendance ratio 0.52.

• *NORTHERN OHIO*—December 11, 1950. During dinner, which preceded the business meeting, members and guests were addressed by Brooks Jones, a lawyer from Cleveland and a member of the Council of World Affairs, who spoke on *Rearmament of Germany*. The business meeting was called to order in the Warner Auditorium by Pres. W. M. Rowe and the minutes of the November 13 meeting were read and approved. President Rowe announced that Lester T. Avery, president of the Society, had met with the board of governors prior to the chapter business meeting. Mr. Avery briefed the board on the activities of the Society and left many worthwhile suggestions for the chapter officers to consider. The next order of business was the election of a member and alternate member to represent the Northern Ohio Chapter on the Chapters Conference Committee. John Richmond was elected the member and L. C. Burkes was elected alternate member.

The meeting was then turned over to C. M. Humphreys, who introduced the speaker of the evening, A. J. Hess, member of the Chapter Relations Committee and member-owner, Hess-Greiner & Polland, Los Angeles, Calif. Mr. Hess spoke on *High Temperature Hot Water Heating*, defining this method of heating as one in which the water temperature was above 212 F, with the pressure high enough at all times to prevent boiling in any part of the system. He stressed the simplicity of the design procedure and its widespread application in the southwest to industrial heating problems. Mr. Hess emphasized the need for careful attention to pressure losses in the system and local pressures in order that the pressures at all points be above the boiling point. He stated that the one-pipe system using high temperature, high velocity hot water showed definite economies as compared to steam in large installations.

Mr. Hess concluded his talk by describing the Phytotron at the California Institute of Technology. This is an experimental greenhouse with some forty rooms held at different temperatures and humidities in order to study plant growth by subjecting the plants to various predetermined cycles of temperature and humidity. Mr. Hess' interesting and informative talk was well received by the audience and an interesting discussion period followed. Attendance 66.

• *OKLAHOMA*—November 22, 1950. Pres. R. E. Swan presided and called the meeting to order at 8:00 p.m. at the Skirvin Hotel, Oklahoma City. The roll call was by signature and the reading of the minutes was dispensed with. W. E. Suchan, Jr., president of the Student Branch at Oklahoma A & M College, Stillwater, was introduced and gave a report on the Student Branch.

The guest speaker of the evening, Lester T. Avery, Cleveland, Ohio, president of the Society, was introduced. Mr. Avery in his preliminary remarks gave a report on the activities of the Society and the work of the Chapter Relations Committee. In his talk on *Dynamic Air Conditioning*, he said that unless the surrounding air acted as a medium to remove heat from the human body, it would actually burn up, since each individual generates enough heat to be equivalent to a 100-watt bulb. He further stated that it is not true that everyone desires a different temperature since there is a temperature that he maintains is both effective and comfortable for practically everyone. Mr. Avery explained that if the temperature is kept between 73 and 78 deg and the humidity between 30 and 50 percent, the majority of people will be comfortable and will work efficiently.

Mr. Avery stressed the importance of air purity and quality and emphasized that different kinds of atmospheric pollutants require different treatment so that the proper treatment of air for purity would include a number of different steps. Mr. Avery gave an excellent presentation and the meeting adjourned at 10:30 p.m. Attendance 68. Attendance ratio 0.40.

• *OREGON*—November 9, 1950. The meeting was called to order in the Old Heathman Hotel by Pres. R. C. Chewning and the minutes of the previous meeting were read and approved. Reports were made by the chairmen of the membership, social and meetings committees. A motion was passed instructing the Secretary to write a letter to Piertro Belluschi congratulating him on behalf of the chapter on his recent appointment as dean of the architectural department of M.I.T. and inviting Mr. and Mrs. Belluschi to attend the December meeting of the Oregon Chapter. President Chewning read a letter from K. F. Baldwin, president of the Golden Gate Chapter, offering any desired assistance to the Oregon Chapter in the promotion of the 1951 Semi-Annual Meeting in Portland.

The meeting was turned over to J. D. Kroeker, who brought the chapter up to date on the activities of the City Committee on Air Pollution and introduced the speaker of the evening, Jack Hubbard, who spoke concerning the nature of air pollution and the many problems it brings to those endeavoring to formulate controls, laws and codes. Mr. Hubbard's talk covered all phases of the problem and suggested various avenues of approach to a solution.

Mr. Kroeker then introduced Lawson McCall, executive assistant to Governor Douglas McKay, who acquainted the chapter with the steps that the state government is taking in an effort to combat the air pollution problem in Oregon before it reaches such serious proportions as now exist in other west coast areas. Mr. McCall then introduced Dean Price, a member of the State Committee on Air Pollution, who indicated that the State Committee as it now stands has at its disposal an excellent collection of brains and abilities. He stressed the point that the State Committee is approaching the problem in an extremely thorough manner and will carry all investigations on in such a way that the code as finally written should be mutually satisfactory to all groups concerned. The next speaker was Mr. Benard, of the City of Portland Department of Buildings, who expressed satisfaction with the steps that had been taken thus far to combat the air pollution problem in the Portland area and expressed the desire of the Department of Buildings to be cooperative and helpful in any way possible. Attendance 84.

• *PHILADELPHIA*—December 12, 1950. The meeting was called to order in the Engineers Club at 7:35 p.m. by Pres. J. W. McElgin and the minutes of the previous meeting were read and approved, followed by the report of the treasurer, which was approved as read.

The speakers of the evening, Andrew T. Browne, of A. C. F. Brill Co., and L. F. Reynolds, of the Budd Co., were introduced. Mr. Browne spoke on *Motor Coach Air Conditioning* and Mr. Reynolds' talk was on *Railway Car Air Conditioning*. Both talks were well presented and well received by the audience. The meeting adjourned at 9:30 p.m. Attendance 104. Attendance ratio 0.34.

• *PHILADELPHIA*—November 9, 1950. Pres. J. W. McElgin called the meeting to order at 7:45 p.m. at the Engineers Club and the minutes of the previous meeting were read and approved. Following the reading and approval of the treasurer's report, the guest speaker of the evening, G. L. Wiggs, senior partner, Wiggs, Walford, Frost & Lindsay, Montreal, was introduced. Mr. Wiggs spoke on the subject *Radiant Heating and Cooling* and gave a very interesting presentation which was well received. The meeting adjourned at 9:40 p.m. Attendance 120. Attendance ratio 0.44.

• *PITTSBURGH*—December 11, 1950. Following a social hour in the Hunt Room of Webster Hall and dinner in the Colonial Room, the business meeting was called to order by Pres. A. F. Metzger and the minutes of the November 13 meeting were read and approved as read. W. D. Simpson reported that the speaker at the January Meeting would be John W. James, member of Council and chief research engineer, McDonnell & Miller, Inc., Chicago, Ill.

Mr. Simpson then introduced the speaker of the evening, Raymond Mancha, vice president, ventilation equipment, Joy Mfg. Co., Pittsburgh, Pa., who spoke on *Axial Fans and Their Application*. Mr. Mancha introduced Dr. T. H. Troller, vice president in charge of engineering, Joy Mfg. Co., who is responsible for the design of the firm's fans. Preceding the talk, Mr. Mancha showed a sound film in full color of the manufacturing of fans. At the conclusion of the film, he described the close tolerance between the fan blades and housing, the performance (with the cost of operation of various types compared), and the space saved. He mentioned that there are two types of axial fans — tubeaxial and vaneaxial — and spoke of the difference between the two as follows: Tubeaxial fans are generally used against resistance, and commonly have relatively large hubs and helical blades. Vaneaxial fans incorporate guide vanes to modify performance and increase efficiency. All types of axial flow fans vary in shape, number of blades, their angles, and ratio of hub diameter to impeller diameter. The meeting was adjourned at 9:55 p.m. Attendance 41.

• *ROCKY MOUNTAIN*—November 1, 1950. Pres. R. W. Petersen called the meeting to order at 7:45 p.m. in the Silver Wing Inn, Englewood, Colo., and following the roll call of members, the guests were introduced. The minutes of the previous meeting were read and approved and reports were given by the membership and review and the code committees.

The speaker of the evening, F. J. Nunlist, chief engineer, L. J. Mueller Furnace Co., Milwaukee, Wis., was introduced. Mr. Nunlist spoke on *Modern Trends in Warm Air Heating*, using slides to illustrate his talk. Mr. Nunlist discussed the advancements made in residential warm air heating as the result of research carried on since the war. A question and answer period followed the talk which indicated the fine response and the interest shown in Mr. Nunlist's talk. At the conclusion of his talk, Mr. Nunlist was extended a vote of thanks.

Fred Janssen reported that five ASHVE members were on the roster of the Code Committee of the City and County of Denver, which is now undertaking to revise the Heating and Ventilating Sections of the Building Code. The meeting adjourned at 9.55 p.m. Attendance 59. Attendance ratio 0.48.

• *ROCKY MOUNTAIN*—October 4, 1950. The meeting was called to order by Pres. R. W. Petersen in the Silver Wing Inn, Englewood, Colo., and the minutes of the previous meeting were read and approved. The roll call of members and the introduction of guests were followed by a report of the entertainment committee.

Carl F. Boester, housing consultant, Purdue Research Foundation, Purdue University, W. Lafayette, Ind., was the speaker of the evening,

and Mr. Boester's topic was *High Temperature Forced Hot Water Heating*. Mr. Boester described current practices in high temperature forced hot water heating as a result of his observations on a recent tour of Great Britain and some continental European countries. He described, in some detail, the heating system at Buckingham Palace in London and the widespread use of high temperature water as the medium for district heating. At the conclusion of the talk, Mr. Boester was given a vote of thanks for his informative and entertaining talk. The meeting adjourned at 10:15 p.m. Attendance 55. Attendance ratio 0.47.

• *SHREVEPORT*—November 15, 1950. The meeting was called to order after a social hour and dinner at the Caddo Hotel by Pres. B. E. Segall, Jr. and the guests at this meeting included the wives of some of the members. President Segall requested a report from the nominating committee for officers for 1951. The following members were nominated: *president*—S. W. Beaty; *vice president*—R. W. Hood; *secretary*—W. S. Evans; *treasurer*—M. A. Hudson; and *board of governors*—L. C. Haas, B. E. Segall, Jr., and J. B. Struwe. A motion was passed unanimously electing the nominees as the new officers for 1951.

President Segall then introduced the honored guest of the evening, Lester T. Avery, president of ASHVE, Cleveland, Ohio, who explained briefly the aims and activities of the Society. Speaking on *Dynamic Air Conditioning*, Mr. Avery stated that an individual generates enough heat to be equivalent to a 100-watt bulb, which is enough to burn you up if the air around you did not act as a medium to remove the heat from your body. Mr. Avery dealt with some common misconceptions about temperature and declared that heating and air conditioning engineers know more than they are putting into practice. He said that not everyone wants a different temperature, stating that there is a temperature that is effective and comfortable for nearly everybody.

Mr. Avery emphasized the importance of air purity and quality and pointed out that we have the knowledge and the technique to remove air borne bacteria and other pollutants. He said it is necessary to note that the different kinds of atmospheric pollutants require different kinds of treatment. For example, bacteria and virus require one kind of air purification, dusts another, gases and fumes a still different one, so that the proper treatment of air purity would include a number of different steps. All of these are proved and ready for use in the hands of the skilled technician, he declared.

Concluding his talk, Mr. Avery said: "I challenge you to use the knowledge, the skills, the tools of our profession which are available. You frequently are willing to compromise because of the cost. Mankind's development, the increase in life span, and the freedom from pestilence and plague have been made possible by man's use of knowledge to control his relationship to his environment. Here we are in a position to control the environment. This is your obligation and your opportunity." Following the conclusion of his talk, Mrs. Avery was introduced to the group and thanked for being the Chapter's guest. Attendance 52.

• *SOUTH TEXAS*—November 17, 1950. Members and guests met at Bill Williams Restaurant and Pres. H. W. Broadwell called the meeting to order, after which the minutes of the preceding meeting were read and approved. Reports were given by J. C. Lewis, membership chairman, J. N. Powell, attendance chairman, A. A. Rasmussen, research chairman, and B. P. Fisher, coordinator of student branches. President Broadwell announced that the new roster was about to go to press and E. G. Floeter, Jr., treasurer, gave a financial report.

Reg F. Taylor, treasurer of the Society and consulting engineer of Houston, introduced Lester T. Avery, president of the Society, Cleveland, Ohio, who gave a brief talk on Society activities. Mr. Avery's main talk was on *Dynamic Air Conditioning* in which he stated that there is a temperature that is effective and comfortable for nearly everybody. With a projector and slides he demonstrated how greatly expanded use of controlled conditions in war plants increased productivity and comfort of workers. He recommended the use of bactericidal lamps and glycol to kill airborne germs. He stated that too many engineers considered only temperatures and that most consideration should be given to cleaning of the air. Mr. Avery recommended the following books as reading suggestions to the membership: "Industrial Health Engineers", "Public Health Engineers", and "Temperature and Human Life." Attendance 96. Attendance ratio 0.40.

• *SOUTHWEST TEXAS*—November 20, 1950. Pres. L. S. Pawkett called the meeting to order in the Tapestry Room of the St. Anthony Hotel, San Antonio, and the minutes of the preceding meeting were read and approved as read. An auditing committee was appointed consisting of the following members: A. T. Moses, J. L. Rea, Jr., and D. F. Schuett. The following chapter officers were elected for the 1951 season: *president*—I. W. Wilke; *vice president*—W. E. Long; and *secretary-treasurer*—D. E. Locher.

Dr. F. E. Giesecke, past president of the Society, introduced Lester T. Avery, president of the Society, Cleveland, Ohio, who gave a short talk on the history, organization, aims, and accomplishments of the Society, which was followed by a brief intermission. At the conclusion of the intermission, Mr. Avery began his talk on *Dynamic Air Conditioning*. Mr. Avery stressed the importance of conditioning of air because of the two aspects in which the human body is influenced by air: the air that we breathe and the air as a body environment. Con-

ditioning the air for the first purpose is of extreme importance, especially in industrial sections of the country where air contamination and pollution are most common. Here there is a very important problem of air cleaning and purifying and of bacterial control. Mr. Avery suggested several sources of information on air cleaning and purification, mentioning the use of air filters, washers, glycol spray, and germicidal lamps, and stated that there is much to be learned in these fields of air treatment.

He reminded the audience that the ASHVE Research Laboratory has done much in the way of study of the air as body environment. He mentioned particularly the need to include in the comfort chart the factor of radiant energy as it influences the human body. The speaker stated that the body works most efficiently when in a "neutral" atmosphere; that is, when the heat generated by the body is exactly balanced by its ability to give off this heat to the environment. Other factors such as shock, humidity, acclimatization, and "threshold of resistance" of the body and of the surrounding atmosphere were discussed in a most interesting manner. Attendance 58. Attendance ratio 0.48.

• *VIRGINIA*—November 15, 1950. Pres. W. P. Robinson called the meeting to order at 8:20 p.m. and after welcoming the guests, called for the reading of the minutes of the October meeting. This was followed by the reading of reports by the treasurer and the nominating committee. E. D. Duval reported for the ASA B-9 Safety Code Committee recommending that the chapter concur with any group trying to get the code enforced by the City of Norfolk, stating that the committee found that the ASA B-9 Safety Code is already a part of Norfolk's Codes.

The speaker of the evening, P. L. Davidson, consulting engineer of Philadelphia, Pa., was introduced. Mr. Davidson's subject was *Industrial Air Conditioning* and he began by explaining how the textile industry had been a leader in the air conditioning field, and he had found it so interesting so as to take him away from the field of comfort cooling. He compared the various air conditioning systems used in the textile industry and pointed out their merits and their shortcomings. He stated that the importance of clean air in the mills was emphasized by its effect on the color and price of the final product; mentioning that dirty cloth is either dyed a dark color or sold as seconds, with pastel shades bringing the highest prices. In closing, he commented on the problems which windows present to industrial air conditioning and stated that he does not know of any textile mill being built today that has windows in it. Mr. Davidson's talk was followed by a question and answer period. Attendance 15. Attendance ratio 0.35

• *WISCONSIN*—December 11, 1950. Dinner was served at 6:30 p.m. in the Engineers Society Building, at the end of which Pres. F. J. Nunlist welcomed the members and guests. The minutes of the November meeting were read and approved and reports were given by the membership, meetings, and program committees and by the secretary, N. E. Hill.

The speaker of the evening, John W. James, chief research engineer, McDonnell & Miller, Inc., Chicago, Ill., was introduced. Mr. James' subject was *Hot Water Heating* and he opened the discussion with a description of the tower of heat in England whereby water used to cool the condensers of a power station, is stored in a large insulated vessel and then used for heating a housing development. This hot water was formerly wasted into the river and the point was brought out that where large quantities of heat are now wasted, consideration should be given to the probable use of this heat.

Mr. James gave a detailed history of the development of hot water heating and gave specific reference to the handbook on heating first published in 1910 and authored by Professor Hoffman of Purdue University. Mr. James stated that there has been a tendency in recent years to increase the pressure and temperature of hot water heating systems so as to reduce the size of the system piping as well as to reduce the size of installed heat dissipating means in the rooms, such as radiators, convectors, and unit heaters. A number of precautions were cited in the design of hot water heating systems with specific reference to avoid having the closed hot water tanks becoming waterlogged because of inadequate size and because of improper piping between the boiler and the expansion tank.

Details in the current designs of relief valves were shown in reference to troubles encountered in relief valves made several years ago. He stated that even on a hot water heating system full protection can only be accomplished if a water feeder is installed on the boiler together with a properly designed and located low-water cutoff. Reference was made to the *ASME* Code provisions, which specify that on large sizes of hot water boilers, where several safety valves are required, one coded hot water relief valve can be used in conjunction with one or more steam pop safety valves. Following the discussion period, the speaker was extended a rising vote of thanks. Attendance 65. Attendance ratio 0.24.

STUDENT BRANCHES

• *UNIVERSITY OF TEXAS*—November 7, 1950. Pres. L. E. Scott called the meeting to order at 7:30 p.m. in the Engineering Building and the minutes of the October meeting were read and approved. Prof. W. E. Long urged the students to attend the Southwest Texas Chapter meeting on November 20, stressing that the program for the evening consisted of a social hour at 6:30 p.m., dinner at 7:30 p.m., followed by the business meeting at which President Lester T. Avery would speak on *Dynamic Air Conditioning*.

President Scott introduced I. W. Wilke, heating engineer, Southern Union Gas Co., Austin, and co-sponsor of the University of Texas Student Branch, who in turn introduced the speaker of the evening, A. T. Moses, partner, Darley and Moses, Austin. Mr. Moses spoke on *Prospective Engineers*, emphasizing the importance of the engineer gaining the confidence of the other professions and of holding active membership in a technical organization such as the ASHVE or *ASME*. Attendance 19. Attendance ratio 0.58.

• *UNIVERSITY OF TEXAS*—October 17, 1950. The meeting was called to order in the Engineering Building at 7:00 p.m. by Pres. L. E. Scott and the minutes of the previous meeting were read and approved. President Scott then read the appointments for the various committees as follows: *program*—R. M. Tittle, *chairman*, W. A. Cox, M. W. Ferguson, E. F. Barnes; *publicity*—M. F. Klevar, *chairman*, J. W. Paxton, W. N. Buck, H. C. Ferguson; and *membership*—M. A. Drews, *chairman*, A. J. Gillian, E. F. Schroerluke. A lengthy discussion was held concerning the publication of the student branch paper, the Register, and D. P. Collins, who is doing most of the work, urged members to bring any news which might be of interest. Mr. Schroerluke volunteered to assist Mr. Collins in publishing the paper.

Three pictures, "1949 Highlights of Southwest Conference Football", "Rocky Mountain Trout", and "Music of America", were shown. Attendance 16. Attendance ratio 0.60.

Candidates for Membership

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society, or mailed to all members. When the replies are received from references the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month 91 applications for membership, including 47 student applications, 2 reinstatements; and 13 advancements have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by February 28, 1951, these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

BURKE, D. J., Designer, Edward J. Long, Cons. Engr., Springfield, Ill. REFERENCES: B. E. Hadley*, N. P. Hall, E. J. Long, E. C. Worthington*.

CARMACK, E. W., Sales Engr., Armstrong Cork Co., Houston, Tex. REFERENCES: A. M. Chase, Jr., G. J. Collins, Lacy Key, Jr., R. J. Salinger.

CARROLL, F. T., JR., Product Application Engr., Herman Nelson Div., American Air Filter Co., Philadelphia, Pa. REFERENCES: Isadore Director, W. D. Strause, H. M. Teuber, E. K. Wagner.

CRABTREE, J. D., Sales Engr., Clarage Fan Co., Washington, D.C. REFERENCES: S. R. Allen, H. H. Hill, W. L. Hoover, Glegge Thomas.

DEMARTINI, R. J., Chief of Plbg. & Htg., Huffman-Wolfe Co., Atlanta, Ga. REFERENCES: A. C. Gowdy, E. K. Jamison, I. B. Kagey, W. S. Miller.

DOENCH, F. H., JR., Htg. Designer, Schweiger, Heapy & Associates, Dayton, Ohio. REFERENCES: George Arnold*, Howard Fielder*, M. O. Heapy, J. M. Schweiger.

DYMOND, D. M., Testing Engr., Canadian Standards Assoc., Toronto, Ont., Canada. REFERENCES: J. D. Barnes*, D. T. Hewson*, G. Moes*, J. H. Parkin*.

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FRANKE, R. P., Sales Engr., Edwin H. Taze Co., Baltimore, Md. REFERENCES: John Engalitcheff, Jr., F. M. Hewitt, W. W. Hill, E. H. Taze.

GADELL, J. M., Owner, John M. Gadell & Co., Ocala, Fla. REFERENCES: Sydney Anderson, Jr., R. J. Clark, H. A. Daugherty*, J. S. Farr*.

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STUDENTS

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STINE, C. R.
WALL, L. A.

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BURCHETTE, G. E.
FORD, C. A., JR.
MYERS, F. B.

OKLAHOMA A. & M. COLLEGE, Stillwater, Okla. CERTIFIED BY: R. R. Irwin.

WAGNER, V. O., JR.

OREGON STATE COLLEGE, Corvallis, Ore. CERTIFIED BY: W. C. Baker.

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CAMPBELL, R. B.
DALE, W. D., JR.
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KEMPER, R. S., JR.
LIENHARP, JOHN, JR.
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LOVELL, D. H.
ROBIDART, C. M.
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SHINN, A. W.
STURDEVANT, C. L.
TEMPLER, J. M.

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COUFAL, J. L.

UNIVERSITY OF TORONTO, Toronto, Ont., Canada. CERTIFIED BY: F. G. Ewens.

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BROOKS, R. E.
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KEELER, J. S.
MCINTOSH, W. A.
MERKEL, R. H.
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OROSY, JOSEPH
SCOTT, D. J.
SCOTT, R. J. I.
SINCLAIR, J. P.
SLEMIN, J. A.
WARMSKI, M. S.
WARRING, G. R.
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YERGES, J. J., Engr., Mech. Development, Scott Paper Co., Ridley Park, Pa. REFERENCES: G. L. Larson, John Massard*, D. Pohlman*, Jack Trosley*.

*Non-Member

OBITUARIES

HARRY SIMPSON
Toronto, Ont., Canada

The Society has been informed of the death of Harry Simpson on Monday, November 27, 1950. Mr. Simpson was born on June 3, 1893 in Colinton, Scotland, where he attended grade and technical schools.

During World War I, Mr. Simpson served with the Imperial Engineers and at the close of the war, he went to Canada and started his own business specializing in heating of residences.

At the time of his death, Mr. Simpson was engaged in his own business as a heating contractor.

Mr. Simpson was a member of the Society since 1945 and was also a member of the East York Kiwanis Club.

The Officers and Council of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sincere sympathy to the members of Mr. Simpson's family for the loss they have sustained.

WALTER SPOFFORTH
Seattle, Wash.

Walter Spofforth died suddenly on November 27, 1950 while bowling for the Drake Puget Sound League in Seattle. Mr. Spofforth was born on July 12, 1886 at Hull, England, where he attended grade and high school. He graduated from Hull Science College in 1906 with a mechanical engineering degree.

During 1906-11 Mr. Spofforth served as a marine engineer with W. H. Cockerline Co., Hull, England. This was followed by a number of employments with various firms as a power plant designer, assistant chief engineer, machine shop inspector, construction superintendent, and chief engineer. From 1916-20 he served as chief cost engineer on buildings, machinery, plants, tools and materials with the Air Ministry, London. In 1920-22 he was a mechanical superintendent and plant designer for Montgomery Ward & Co., St. Paul, Minn. From 1922 to 1933 he acted as chief engineer for the Ancker Hospital in St. Paul.

Then, in 1933, Mr. Spofforth moved to Seattle, Wash., where he became chief of mechanical services for the U. S. Penitentiary at McNeil Island. He remained in this job until 1947 when he joined the U. S. Navy as a mechanical engineer.

Mr. Spofforth was also a member of the *American Institute of Electrical Engineers.*

The Officers and Council of the Society extend their sincere sympathy to the members of Mr. Spofforth's family.

LOUIS A. CALCATERRA
Grand Rapids, Mich.

Louis A. Calcaterra died early this past Christmas morning in St. Mary's Hospital of a heart ailment. Mr. Calcaterra was born on October 1, 1905 in Norway, Mich., where he attended school.

From 1924-29 he was employed with the Wisconsin-Michigan Power Co., Iron Mountain, Mich., as sales and service manager of the appliance department. In 1929 Mr. Calcaterra joined Sears, Roebuck & Co. as sales and service manager of the plumbing and heating department and from 1936 to 1947 served in the same capacity for the heating, stoker and air conditioning division of the Bennett Fuel Co. In 1947 he joined Harold C. Geer in the Radiant Heating and Supply Co., remaining active with the firm until about seven months before his death when ill health forced him to retire.

Mr. Calcaterra served as secretary of the Western Michigan Chapter of the ASHVE and as president of the Grand Rapids Heating Club. He was a member of the *National Association of Power Engineers*, the *Michigan Sheet Metal Roofing, Heating, and Air Conditioning Contractors' Association* and the Benevolent and Protective Order of Elks. Mr. Calcaterra was one of the framers of the Grand Rapids safety code for the heating industry.

The Officers and Council of the Society extend their sincere sympathy to the members of Mr. Calcaterra's family.

DONALD R. STEEVES
Toronto, Ont., Canada

Word has been received of the sudden death of Donald R. Steeves on December 8, 1950. Mr. Steeves was born on July 24, 1904 at Dorchester, New Brunswick, Canada, where he attended school.

At the time of his death, Mr. Steeves was manager of Steevesway Heat in Toronto, Ontario. Immediately preceding this association, Mr. Steeves was service manager for the Iron Fireman Mfg. Co. of Canada, Ltd., in which capacity his duties consisted of supervising service and maintenance of stokers.

The Officers and Council of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sincere sympathy to the members of Mr. Steeves' family.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Headquarters: 51 Madison Ave., New York 10, N. Y. (Tel. Murray Hill 3 0291)

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First Vice President.....Ernest Szekely
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Two Years: John E. Haines, John W. James, E. R. Queer, Graeme B. Supple.

One Year: Spencer W. Boyd, C. Rollins Gardner, J. Donald Kroeker, Charles O. Mackey, Lester T. Avery.

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Membership: C. Rollins Gardner, *Chairman;* John E. Haines, J. Donald Kroeker.

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Two Years: Carl F. Boester, Robert C. Cross, Richard S. Dill, Arthur J. Hess, Harold A. Lockhart.

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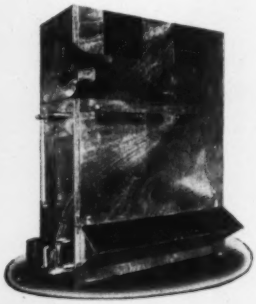

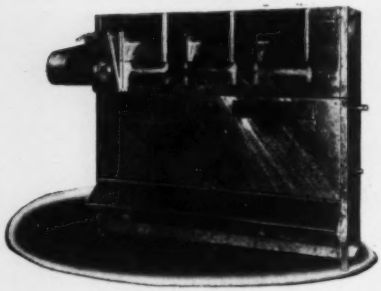

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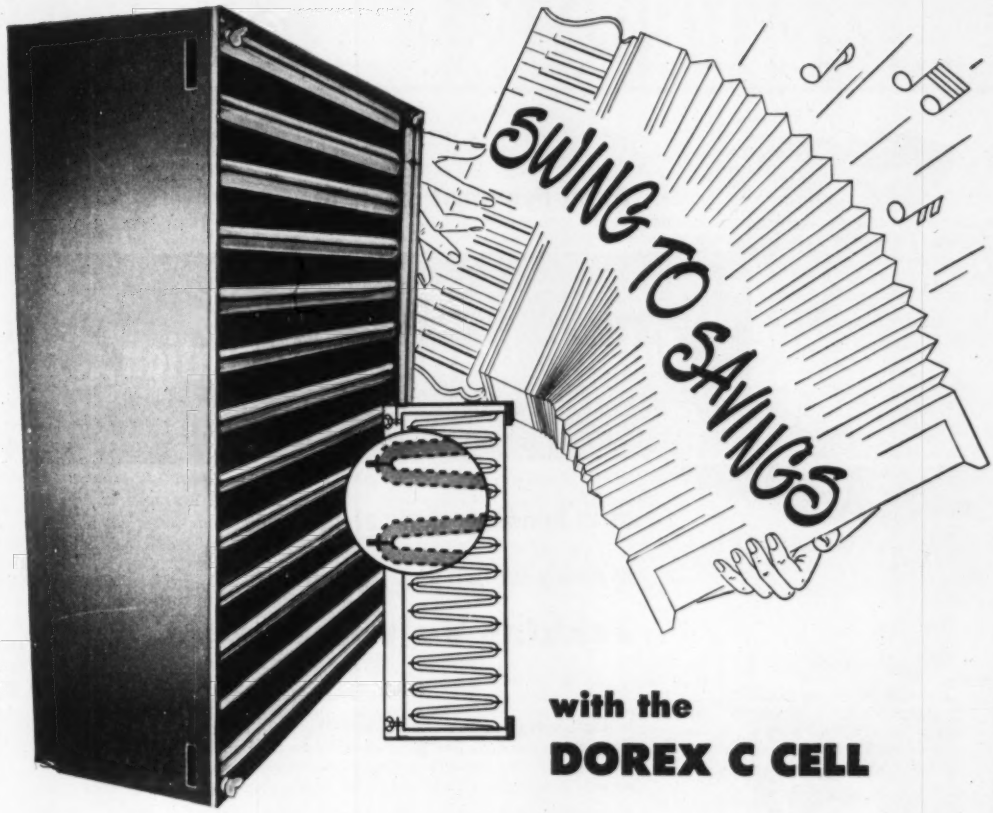

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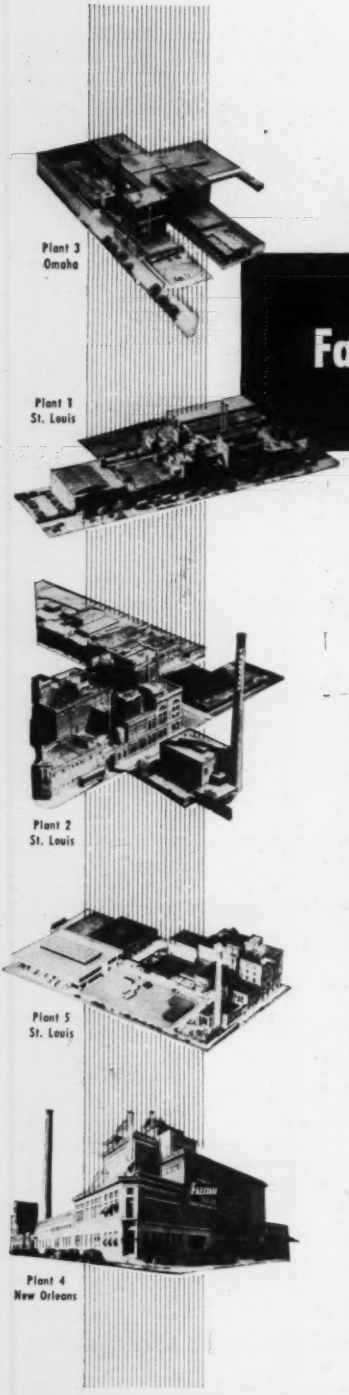


At all five great plants of . . .

Falstaff Brewing Corporation...

as in buildings that set the pace in every industry . . . you'll find

Jenkins Valves

In the brewing of Premium Quality Falstaff, Yesterday and Tomorrow meet. At five great plants — in St. Louis, Omaha, and New Orleans — Falstaff Brewing Corporation combines ancient brewing skills with the most modern brewing methods.

To produce, and maintain, the same "premium quality flavor" in different breweries is no small accomplishment. Falstaff employs not only the latest in scientific knowledge but, for absolute uniformity of product, the most dependable equipment modern engineering can devise. That is why Jenkins Valves are on the pipelines in all five Falstaff plants.

Modern brewery, super-airport, or skyscraper — wherever unfaltering efficiency and long service life are "musts" in operating equipment, you'll find Jenkins Valves. They have been the choice, consistently, of leading architects, engineers and contractors for the buildings which are shaping America's skyline of Tomorrow.

For Jenkins builds extra endurance into valves — proved by low upkeep cost records in every type of service. Yet, despite this extra value, *you pay no more* for Jenkins Valves.

For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

Sold through leading Distributors everywhere

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK

Jenkins Bros.

EQUIPMENT DEVELOPMENTS...

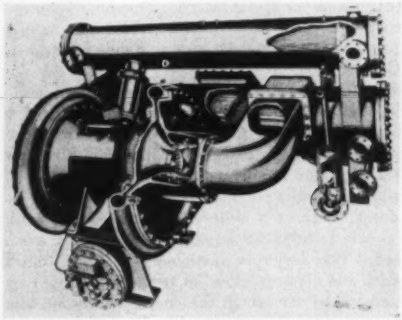
For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1951 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk, equipment and manufacturer not listed

Hermetic, Centrifugal Refrigeration Unit

HPAC 1—Low operating, maintenance, and installation costs, together with unusual flexibility, are claimed for the new "Centravac" centrifugal water chilling unit introduced by The Trane Co., La Crosse, Wis.

The new unit is said to combine advantages of centrifugal design, hermetic sealing, and variable capacity for installations such as office buildings, hotels, apartments, department stores, and industrial plants.

The compressor-motor assembly is shipped hermetically sealed from the plant, and according to the manufacturer, the bulk of installation work can be done by steamfitters



and electricians. The unit uses "Freon-13" and the hermetic design of the two stage compressor-motor assembly eliminates shaft seals. Impellers for both stages of compression are mounted directly on the constant speed motor shaft. There are only two bearings in the entire unit, and these are lubricated by filtered and temperature-controlled oil.

The capacity control or unloading system consists of variable vanes in the inlets of both low and high compression stages. The system is said to assure smooth, efficient operation from 100 percent down to approximately 10 percent capacity. The unit can be started or stopped by pushbutton control or may be controlled thermostatically to modulate, stop and start automatically, thus maintaining a constant temperature in the cooling water supplied to the air conditioning system. A feature stressed by the manufacturer is the almost constant ratio between cooling demand and power consumption through the normal operating range.

The new refrigeration unit is designed to provide chilled water from 40 to 52 F with leaving condenser water temperatures of 80 to 100 F. It is being manufactured in five sizes from 45 to 190 tons and larger sizes are planned.

Combination Line Starter

HPAC 2—A new combination line starter, class 11-206-N, combining motor starter, motor protection, and disconnect in a redesigned enclosure to save space and increase safety is now available from Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30.

Designed for across-the-line starting of squirrel cage induction motors, or as a primary switch for wound rotor motors, this unit features the new "Life-Linestarter," AB de-ion circuit breaker, and slamproof self-indicating interlocked handle. With capacities from ¼ to 100 hp, the unit is available in NEMA sizes 0 through 4, and NEMA type enclosures, 1, 1A, 3, 4, 5, 7, and 9.

Powder Actuated Fastener

HPAC 3—Dual action has been added as the principal feature of 14 new improvements in the light duty powder actuated fastening tool of Ramset Fasteners, Inc., 12117 Berea Rd., Cleveland 11.

The dual action is designed to provide a choice of either "turn" or "tap" operation, depending upon varying working conditions. Turn operation is designed for general working conditions, whereas tap operation has been retained for applications which are in confined locations and for those who prefer it. The use of tap opera-

FOR YOUR CONVENIENCE [2-51]

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31									
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122								

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

tion is said to shorten the tool by nearly 3 in. As before, a fastener and powder load are inserted in the tool which is placed against the work. The drive pin or threaded stud is seated in concrete, steel, masonry, or other building materials. According to the company, this is the first time any powder actuated fastening tool has provided users with two methods of operation on one model.

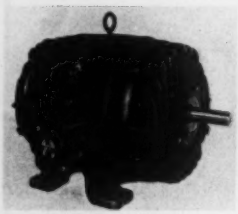
Other features are designed to provide increased protection to operators and add to its ease of operation.

Totally Enclosed Squirrel Cage Motors

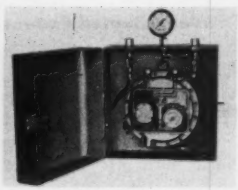
HPAC 4—Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, has recently extended its line of type QZE, totally enclosed, nonventilated, squirrel cage induction motors to include continuous duty ratings built in the NEMA standard frame 284. At present, 7½ hp, 1800 rpm and 5 hp, 1200 rpm motors are in production.

These motors conform in all respects to NEMA and ASA standards for totally enclosed machines, and are identical in mounting dimensions with standard totally enclosed, fan-cooled motors of the same ratings. They are recommended for service in adverse locations where dirt, dust, lint, metal turnings and sand are prevalent, since there are no ventilating openings to clog.

The company's "Copperspun" rotors are used and ball bearings are of the cartridge type with grease space to permit sealing for the life of the bearing if desired, but with provisions for flushing and regreasing.



Totally Enclosed Motor



Air Velocity Controller

Air Velocity Controller

HPAC 5—A new, proportional action velocity controller, for controlling air velocities from 50 to 250 fpm, has been developed by Johnson Service Co., 507 E. Michigan St., Milwaukee 2.

While many applications of the new controller are possible, it is designed primarily to control the velocity of air through the doors of fume hoods employed in working with radioactive materials, where a fixed velocity is required with variable door openings. It is being used in atomic energy and cancer research projects.

Operation of the instrument is based on the fact that the velocity of air, moving between two points, is proportional to the difference in pressure between those points.

The regulator is said to respond to pressure variations of 0.0001 in. of water and to control velocities within ±10 fpm. The instrument consists of a light, flexible diaphragm operating a pneumatic control mechanism. One side of the diaphragm is exposed to the pressure within the laboratory, and the other side is connected to an averaging pressure tip located within the fume hood. Thus, the diaphragm responds to the difference in pressure which causes flow through the hood door and automatically takes into account which of the two pressures is higher. The sensing diaphragm actuates a lid which opens and closes a leakport. The pressure difference on the diaphragm results in a proportional leakport pressure, which in turn, actuates a pilot type relay used to vary the control pressure to the damper or other controlled device.

Automatic Coal Burning Boiler

HPAC 6—The new 260-M "Anthratube" of Axeman-Anderson Co., 233 West St., Williamsport 3, Pa., is an anthracite, coal burning boiler having a capacity of 260,000 Btu per hr and is said to be ideally suited to multiple installations. It is recommended for use in churches, schools, garages, service stations, greenhouses, etc.

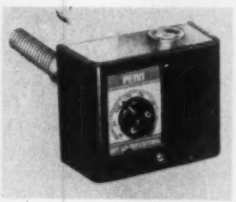
It is designed to automatically take anthracite from the bin, burn it, and shake the ashes into a container or pit. When a room thermostat or operating control is satisfied, the induced draft fan stops. The induced draft, which is used to keep an off-balance plate drawn against the sight tube in front of the unit, also stops. The off-balance plate then falls open and admits overfire air, permitting immediate banking at low output.

Hot Water Immersion Control

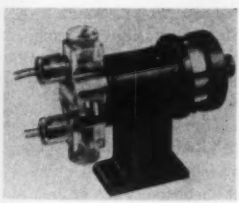
HPAC 7—A new hot water immersion control, described as "trigger quick" in its response to temperature change, has been introduced by Penn Electric Switch Co., Goshen, Ind.

Designated the series 442 liquid expansion hot water control, the unit incorporates a self-compensated power element which is said to be unaffected by ambient temperatures and which makes possible rapid response to changes in water temperature.

Designed for the new small fast-acting hot water boilers, the control features a close differential and a calibrated dial on which both cut-in and cut-out points are easily adjusted. The device is available as a high limit model (in which the contacts close on temperature rise) or as a low limit model (in which the contacts close on temperature drop). Both models can be obtained with a special immersion element for remote mounting.



Hot Water Control

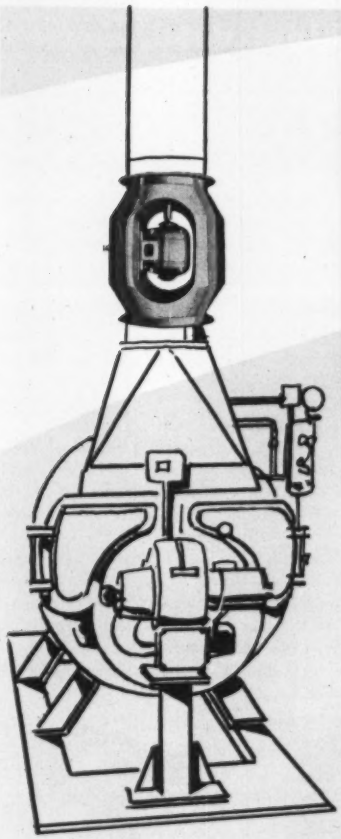


Metering Pump

Small Metering Pump

HPAC 8—The new "Pee-Wee" pump is said to be an accurate, low cost metering pump for low capacities and for use in pilot plant and laboratory applications. The manufacturer is % Proportioneers, Inc. %, Providence 1, R. I.

Designed for operation on 110 volt, 60 cycle, single phase current, the pump is an all-plastic unit having a molded plastic body and a "Lucite" measuring head. It will feed from 100 to 900 cc per min based on a stroking



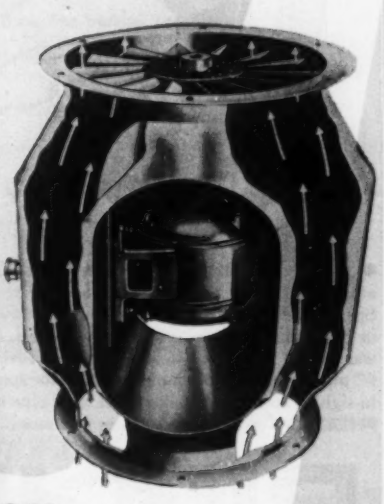
SOLVE DIFFICULT STACK PROBLEMS ECONOMICALLY WITH

DE BOTHEZAT *Induced Draft* BIFURCATOR FANS

There's no guesswork when DeBothezat trained engineers recommend the right Induced Draft Bifurcator Fan for your particular boiler. DeBothezat fan selection is based on more than merely boiler HP or pounds of fuel fired per hour. In addition to this, consideration is given to specific temperatures, the resistance of each boiler to airflow and other confidential data furnished on each make and size of boiler by the manufacturer. With DeBothezat, you're always sure of the correct size fan unit for maximum efficiency.

HOW THE BIFURCATOR WORKS

The DeBothezat Bifurcator is a direct motor-driven fan with a divided housing, easily installed in a vertical stack or horizontal or angular breeching. Gases are by-passed around the motor, which remains cool, clean and easily accessible. No special platforms or supports are required. Standard fan sizes 12" through 36", for boilers having nominal ratings up to 400 BoHP, or 56,000 EDR.



SEND FOR FREE BULLETIN

Descriptive illustrated bulletin, containing diagram and specifications for suggested installation is yours without obligation. Address Dept. H-251.

DE BOTHEZAT FANS DIVISION

American Machine and Metals, Inc., East Moline, Illinois

Extra fast, easy pipe cutting with RIDGID

● It rolls right through any pipe with least effort, quick almost burrless cuts—factory tested, tracks perfectly. Special thin-blade cutter wheel for extra fast cutting—or heavy-duty wheel for extra long service. Guaranteed warp-proof special malleable housing. Five models to 6" pipe; 4-wheel short-handle models for speedy cutting in tight places. For tops in clean, easy pipe cutting, buy RIDGID Cutters at your Supply House.

RIDGID
★ Work-Saver Pipe Tools ★

rate of from 15 to 60 strokes per min, the stroking rate being determined by a contactor and cam arrangement furnished as an accessory to the pump.

Another version of the pump is in the process of development. This will be a hydraulic unit in which the motivating power will be water applied to the side of the diaphragm opposite the push rod. Again, a cam operated contactor can be used to trip a solenoid pressuring valve or the diaphragm chamber can be cross-connected to an intermittent source of pressure.

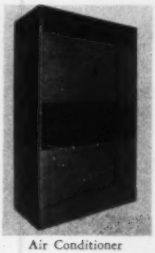
The pump will be commercially available about the first of April.

Packaged Air Conditioner

HPAC 9—A new 11 ton packaged air conditioner has been added to the present line of 2-, 3-, 5-, and 8-ton packaged units of Airtemp Div., Chrysler Corp., Dayton, Ohio.

Equipped with a sealed radial compressor which operates at 3500 rpm, the unit incorporates a return air grille equipped with cleanable type filters. A "Maxifin" cooling coil is used and the combination condenser and receiver is equipped with coil type, spiral finned water passages. Two dynamically balanced fans are used, both suspended in self aligning cushioned bearings and driven by a rubber mounted fan motor. Fans may be operated separately for ventilation when cooling is not required. Other features include an automatic water regulating valve and a built-in thermostat and limit control.

A heating coil is available as optional equipment for year 'round service.



Air Conditioner

Separator

Separator for Steam, Air or Vapors

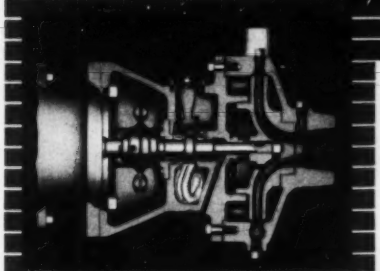
HPAC 10—A new line of separators for use in separating unwanted liquids and solids from steam, air or vapors under pressure or vacuum has been developed by Swartwout Co., 18511 Euclid Ave., Cleveland 12.

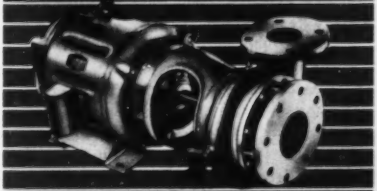
The separators have a smooth helix that gives the steam or air a positive whirling motion which throws unwanted liquids and solids against the wall of the separator where they run down to a drip pocket. According to the manufacturer, the separation process takes place with virtually no pressure drop. In addition, the positive action is said to assure that slugs of water will not be carried into an engine or turbine and oil and grease will not spoil work in process.

Units are made in a variety of styles and sizes. Those made of cast iron are for use with 50, 125 and 250 psi steam, and those made of cast carbon steel are for use with 150, 300, 400 and 600 psi. Sizes range from 1½ to 24 in. Designed in both vertical and horizontal styles, the units can also be made of steel plate to special order.

FOR AIR CONDITIONING AND REFRIGERATION APPLICATIONS...

B & G PUMPS *Challenge Comparison*





These B & G catalogs enable you to select the proper pump for your jobs. Send for your copies.

For eight common-sense reasons, the B & G Series 1522 Centrifugal Pump should be the heart of your water-saving equipment. In cooling tower or evaporative condenser installations you can bank on failure-proof performance and operating economy. Look at these features—

First: Leak-proof Mechanical Seal—ends stuffing box troubles.

Second: Spring-type flexible coupling—contributes to unusually quiet operation.

Third: Hydraulically balanced impeller.

Fourth: Easily serviced. Removal of a few bolts permits separation into three parts.

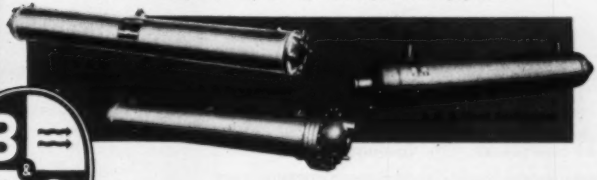
Fifth: Interchangeable parts. The bearing bracket sub-assembly, including shaft and sleeve bearings, is manufactured to close tolerances and is interchangeable in all 1522 Pumps.

Sixth: Shaft alignment maintained by oil lubricated, high grade bronze sleeve bearings.

Seventh: Standard motors—easily obtainable from motor manufacturer's stocks.

Eighth: With all these features, B & G 1522 Pumps are *competitively priced!*

Send for complete data on B & G Refrigeration Equipment



B & G

Hydro-Flo® REFRIGERATION EQUIPMENT

BELL & GOSSETT COMPANY

Dept. RBX-5 Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Road, Toronto, Canada

®Reg. U. S. Pat. Off.

HOW TO SAVE UP TO $5,000 ON AIR CONDITIONING

PAT. NO. 2,297,928

GOVERNAIR
COMPLETELY PACKAGED
AIR CONDITIONER

Save water! Save space! Save installation time and money! Save operating costs! Yes, install Governair and *save from $50 to $200 for each ton* of the completely packaged Governair unit designed to fit your needs!

Experience proves Governair can save you up to $5,000 on a 50-ton Governair unit that gives greater dependability and more "engineered efficiency" than ever before!

If you want the best — if you want the most economical and reliable air-conditioning unit on the market . . . CHOOSE GOVERNAIR and SAVE!

AIR CONDITIONERS

EVAPORATIVE CONDENSERS

BLAST COILS FOR HEATING & COOLING

GOVERNAIR

UNIT COOLERS

GOVERNAIR CORPORATION • 513 N. BLACKWELDER • OKLA. CITY

Force-Balance Controller

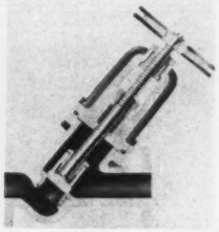
HPAC 11—Taylor Instrument Companies, Rochester 1, N. Y., has developed a force-balance nonindicating controller, the "Transet Tri-Act", for pneumatic transmission systems.

Supplementing the recently announced "Transaire" temperature and pressure transmitters and the miniature recording receivers, the new controller completes the company's "Transet" control system. It is designed to provide fast, accurate measurement of rapidly changing temperatures and pressures, close process control with stability, and continuous process records on a 30-day strip chart.

The new unit contains a circuit with two closed loops in series; the first containing fixed proportional response and adjustable rate action, the second with adjustable proportional response and adjustable automatic reset. Such an arrangement, says the company, gives the controller the ability to apply corrective action to the valve soon enough to prevent process conditions from overshooting or undershooting the set point.

The new controller is designed for use on temperature, pressure, flow or liquid level applications.

Force-Balance Controller



Blowoff Valve

Boiler Blowoff Valve

HPAC 12—Everlasting Valve Co., 49 Fisk St., Jersey City, N. J., has added a straightway Y type valve to its line of boiler blowoff valves.

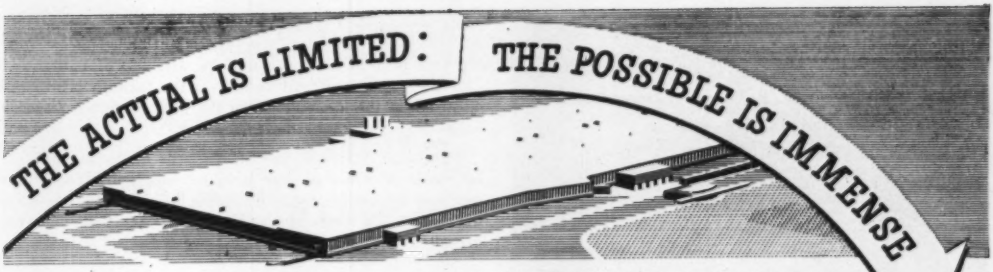
The head or disc is made of H monel metal and the seat is of monel metal. The seat, which is renewable, is provided with upper and lower sealing gaskets to protect the seat threads from corrosion. The stem is of stainless steel and the stem nut is made of bronze. All parts are said to be easily renewable without the use of special tools. This valve, built in conformance with the ASME boiler code, is identical in construction to the company's angle blowoff valve.

The new unit is offered in 1½, 2 and 2½ in. sizes in cast iron or cast steel, for pressures up to and including 600 psi.

Installation of Ceiling Heating Coils

HPAC 13—The new "Rad-Coil" hammer is a combination hammer and holding rig incorporating its own measuring device. It is used to speed up and simplify the job of clamping prefabricated heating coils on the ceiling. The manufacturer is T & H Engineering Co., 401 Main St., Little Ferry, N. J.

The coil is supported and propped in place; after which the device is used to secure the coils permanently.



NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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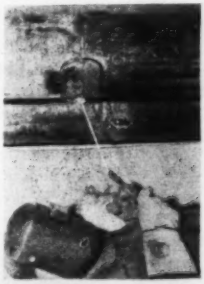
GETS MORE PIPE IN LESS SPACE . . . AT LESS COST

THROUGH the use of short turns and arc welding, piping systems are today being installed at considerably less expense in both new and existing stores and factories. Where pipe must be placed close to walls or columns, the "window" method shown is used. A section is cut out to allow butt welding the inside of the joint. A generous overlap of the outside weld eliminates any danger to leakage. The window is replaced by arc welding with "Fleetweld 5" electrode and using Lincoln "Shield-Arc" welders.

HOW TO CUT PIPE WELDING COSTS
Latest procedures for welding pipe are presented in the new 9th Edition "Procedure Handbook of Arc Welding Design and Practice." Price only $2.00 postpaid in the U.S.A.; $2.50 elsewhere.



Replacing section or "window" after wall side of pipe joint is finish-welded.

Arc welding inside butt joint using Lincoln "Fleetweld 5" electrode.

Section is cut from pipe to form "window" for welding inside of butt joint.

for speeding piping jobs

Faster Welding of pipe in all positions with "Fleetweld 5" electrode speeds installation of air conditioning system. Joints are pressure tested to 280 pounds per square inch.

for simplifying construction methods

Foundation Supports for 12" and 24" pipe are fabricated from I beams and fillet welded to pipe elbows.

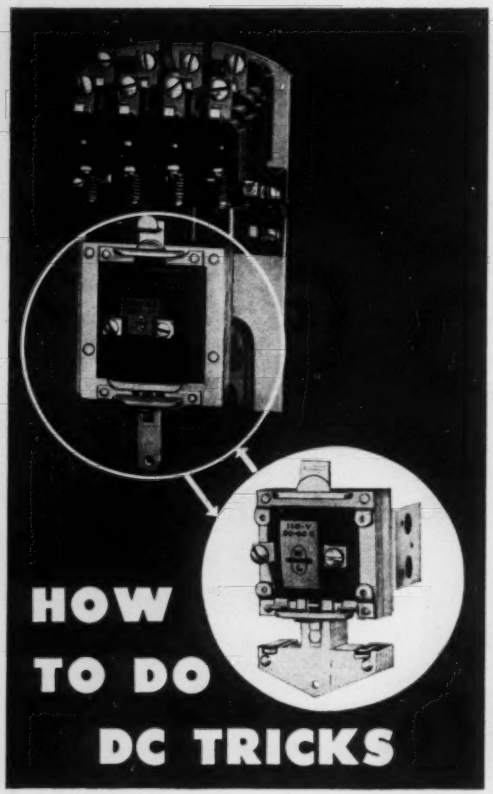
the IMMENSITY of the POSSIBLE

Tougher jobs come easier

SEE HOW "IMPOSSIBLE" JOBS ARE SOLVED WITH ARC WELDING

Handy Welding Guide of Lincoln Electrodes available upon request on your letterhead. Write Dept. 281,

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 1, OHIO



with AC Contactors and vice versa

Put a DC power plant in Ward Leonard's 4110 across-the-line AC magnetic starter, and you can

- . . . do direct AC switching from DC battery voltages
- . . . hold-in despite poor voltage regulation—down to 15% of rated voltage
- . . . eliminate troublesome AC hum

Or use a DC contactor with an AC power plant (Ward Leonard designed the contactors for this) and—

- . . . switch a variable-voltage DC control system from a constant potential AC source
- . . . get dynamic braking just by adding a contact—rather than a separate contactor

Investigate Ward Leonard AC-DC combinations. Write for Control Catalog. WARD LEONARD ELECTRIC CO., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY
Result-Engineered Controls
RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

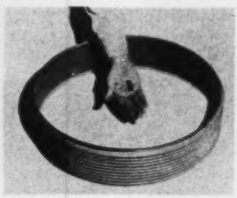
Nails are inserted into the open breech of the device and the clamp is placed into the form-fit head. The measuring arm is used to insure uniform spacing of coils and, with the unclamped coil resting in the form-fit head, the up-stroke of the hammer drives the nails from the breech, imbedding them into the beam.

Two head sizes are furnished — to fit 3/8 in. and 1/2 in. coils. Other sizes can also be supplied. The hammer can be used for ceilings from 7 1/2 ft to 9 ft above the floor. The total weight of the unit is 10 lb and the overall length is 5 ft.

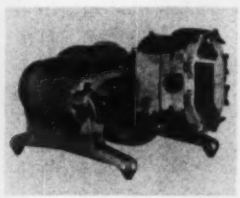
Stainless Steel Bellows

HPAC 14—Hydraulically formed stainless steel bellows in a wide range of sizes from 7/16 in. to 26-3/8 in. in diameter are now available from Clifford Mfg. Co., Waltham, Mass.

The flexibility, strength, corrosion resistance and leak-proof qualities of the bellows are said to make them exceptionally well suited to applications involving the control of temperature and pressure, for shaft sealing, for use in steam traps, and for providing flexible joints for instruments which combine rotary motion and hermetic sealing, as well as the transmission of movement hydraulically to remote points.



Stainless Steel Bellows



Sanitary Pump

Sanitary Pump

HPAC 15**—A new pump for purposes requiring wear and corrosion resistance as well as sanitary qualities has been developed by Waukesha Foundry Co., Waukesha, Wis.

This ball bearing unit is recommended for handling milk, canned foods, carbonated beverages, liquors, cold cream, pharmaceuticals, paints, adhesives, etc. It is a positive displacement twin blade impeller type and is offered in five sizes handling 250 to 60,000 lb per hr against a 100 lb head. Units are designed to operate at speeds up to 650 rpm.

Castings of four different copper-nickel alloys are used for the pump body, cover, impellers, and rotary seal parts; and a fifth alloy containing 20 percent nickel is used for the gear case and cover of the deluxe model. A stainless steel spring is used to keep the proper pressure on the rotary seal. According to the company, the entire pump head, including all rotary seal parts, is easily dismantled and reassembled. Where requirements demand, the unit may be obtained cast in 18-8 austenitic stainless steel. In this case, the impellers are made of an alloy which contains 50 percent nickel.

Shown here is a unit equipped with the new "Shift-speed" which is designed to provide speeds from 15 to 650 rpm.

This material saves you money

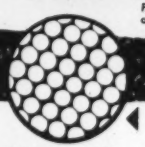
PC FOAMGLAS
the long life insulation

The wide acceptance of Foamglas—evidenced by a long list of prominent users—is mainly due to two facts: 1. Composed of air enclosed in glass cells, it is a proven retardant of heat travel, an unusually *effective* insulation. 2. Being glass, Foamglas successfully resists elements that destroy other materials, consequently gives long lasting insulating service, without costly repairs, maintenance or replacement. That makes it an unusually *economical* insulation.

Foamglas is being used successfully in walls and floors, roofs and ceilings of many prominent buildings, to maintain desired temperature and humidity levels—on hot and cold piping, indoors and outdoors, for heating, cooling and processing systems—on tanks, ducts and other air handling equipment. When properly installed, PC Foamglas retains its original insulating effectiveness.

When you are facing involved insulating problems, consult Pittsburgh Corning specialists for prompt solutions. Meanwhile send for our recently published booklets and folders. They contain many illustrations, specifications and easily understandable instructions for the common uses of PC Foamglas Insulation. Just mail the convenient coupon and we shall be glad to send you a sample of Foamglas and the booklets you select.

PC Foamglas Insulation is used on the walls and ceiling of this cooling room—designed for 32°F. temperature—and on cold pipe lines at the new canning plant of the Krey Packing Company, Belleville, Ill. Insulation Contractor: Gordon Insulation Company, E. St. Louis, Ill.



This diagram shows how a group of glass bubbles which contain still air, can form a continuous, cellular material. PC Foamglas, the cellular glass insulating material, consists of glass and still air, both excellent barriers to heat travel. And, being glass, Foamglas has unusually high resistance to moisture, vapor, fumes and acid atmospheres, is noncombustible, odorless and verminproof. In this cellular glass construction lies the secret of the long lasting insulation value of PC Foamglas.

Pittsburgh Corning Corporation
Dept. AF-21, 307 Fourth Avenue
Pittsburgh 22, Pa.

Without obligation on my part, please send me your FREE booklets on PC Foamglas Insulation for:

Piping & Equipment____ Refrigerated Structures____ Commercial & Industrial Buildings____

Name.....

Address.....

City.....State.....

PITTSBURGH ® PC CORNING

FOAMGLAS cellular glass INSULATION

. . . when you insulate with FOAMGLAS . . . the insulation lasts!

We doubt that you've done much work for the Three Bears lately.

We haven't, either.

But we *can* help heating engineers and contractors provide the proper thermal environment for any client—anywhere—in any kind of structure.

We have a lot of literature on all phases of heating, ventilating and air conditioning. Information you should have in your files.

And we have a lot of very well informed control engineers—in our 89 different offices—who have a lot *more* information right at their finger-tips.

We sincerely believe we can help you on any project that poses problems of control of any kind—for *control* is Honeywell's business.

So, why not *talk to Honeywell?* Why not *write* to Honeywell for complete information on the equipment discussed in the column across the page? And why not do it *now?*

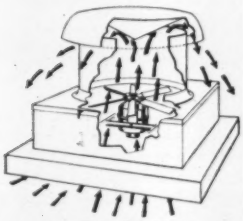
MINNEAPOLIS **Honeywell**

First in Controls

Power Exhauster

HPAC 16—Gallaher Co., 4108 Dodge St., Omaha 3, Neb., is now offering the "Air-Max" power exhauster. According to the company, it does not replace the present "Air-Van" power exhauster but supplements the line for applications where the chief aim is the movement of maximum amounts of dry, uncontaminated air at minimum horsepower.

The unit incorporates a modern, low silhouette (maximum height for the largest unit is 36-½ in.). Air expulsion is downward onto the roof through a weatherproof and light-tight outlet. Where upward discharge is desired, the unit can be supplied without the mushroom cover. The new unit is available in a wide range of sizes with capacities from 1700 to 27,000 cfm. Four or six aluminum alloy propeller fan blades are used and are designed so that they can be replaced in the field without the purchase of an entire new wheel. The blades are also vinylite coated for resistance to acid and alkali fumes.



Power Exhauster

Smoke Indicator

Smoke Indicator

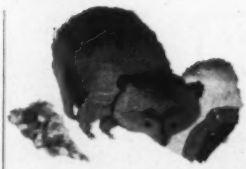
HPAC 17—The new series of smoke indicators manufactured by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., has been developed for continuously indicating the density of smoke passing through the stack or breeching and for signalling whenever the smoke exceeds a predetermined value.

The equipment consists of light source, a photoelectric scanner, and a control and indicator combined in a single housing. The indicator is calibrated in Ringlemann numbers and also in percent smoke (from 0 to 100). Red and green jewel lights provide visual indications of excessive or efficient smoke conditions and an alarm can be set to operate at any smoke density value. The meter reading is independent of the alarm setting.

Corrosive Fluid Valve

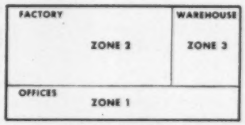
HPAC 18—A new valve, developed by Hills-McCanna Co., 3025 N. Western Ave., Chicago 18, to handle concentrated sulfuric acid and other highly corrosive fluids has a diaphragm said to greatly reduce maintenance problems. Molded of "Bakelite" polyethylene plastic specifically formulated for this purpose, the diaphragm is recommended for all concentrations of sulfuric acid, up to and including oleum, at a maximum of 10 percent excess sulfur trioxide, at temperatures up to 125 F.

The valve has O ring seals in the bonnet assembly to prevent acid from spraying out if mechanical damage should occur to the diaphragm. In addition, a stem assembly prevents the handwheel being turned beyond the

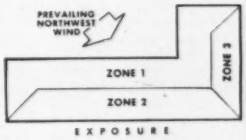


We can't help you heat bear caves, but we can help you plan better Zone Control heating systems. So fill out the coupon below and send it to us for

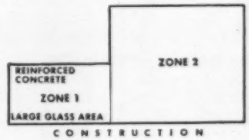
FACTS YOU NEED—FREE!



An excellent way to achieve uniform comfort and economy in heating large buildings—institutional, commercial or industrial—is through the use of Honeywell Zone Control. Separate heating zones in a factory, for example, enable you to keep office workers comfortable in their zone—while at the same time you maintain one low economy temperature in the fabrication zone, and still another fuel-saving level in the storeroom area. And in addition to occupancy and use requirements, Honeywell Zone Control equipment helps you compensate for *all* weather factors and varying heat losses.



In the home field, too, demands for uniform comfort in larger houses have accelerated the trend toward Honeywell Zone Control. For with Honeywell Zone Control you can maintain the desired temperature in every part of the house despite wide differences in exposure, use, occupancy and structural heat losses. And Zone Control makes it possible to lower temperatures for economy's sake during the parts of day when certain sections of the house are not in use.



For additional, specific information on the use of Zone Control, fill in and mail the accompanying coupon now. It will bring you material you'll want to read—and keep handy in your files.

MINNEAPOLIS-HONEYWELL REGULATOR CO.
Minneapolis 8, Minnesota, Dept. HP-2-20

Gentlemen: Please send me information on Zone Control heating for

☐ Large buildings ☐ Homes

Name _____

Firm Name _____

Address _____

City _____ Zone _____ State _____

WHY THEY CHOOSE
Badger
EXPANSION JOINTS

The largest operating Utility in New England

"D-F S-E Joints installed in early thirties are still on the job"

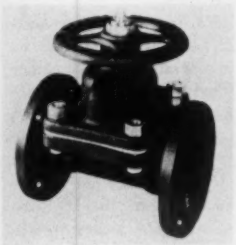
Back in the early thirties the now-famous Badger Directed-Flexing principle was added to the Self-Equalizing construction. The principle underlying the idea (see illustration below) looked sound to the Utility Engineers and several joints were ordered and installed in their central heating distribution system. Badger D-F S-E Joints are still on the job.

With this Utility, as with hundreds of others, Badger Directed-Flexing Self-Equalizing Expansion Joints are famous for performance. Reason? *Exclusive* construction features which guarantee longer life without maintenance. So be wise, figure in terms of *costs* and specify Badger Joints. Send for your copy of new 24-page catalog.

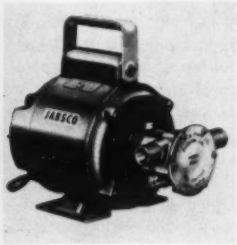
Badger Joints flex like this . . .
not like this . . .
All-curve flexing guarantees longer life
EXCLUSIVE construction of Badger Joints eliminates localized flexing stresses that cause breakdowns. Directed Flexing Equalizing Rings control and contain movement to all-curve pattern — distribute stresses to all parts of flexing member.
COLD
HEATED

Badger
MANUFACTURING COMPANY
230-260 BENT STREET CAMBRIDGE 41, MASS.

point necessary to close the valve tightly and thus injuring the diaphragm. Available in ½, 1, 1½, 2, and 3 in. sizes with either flanged or screwed ends, the valves are made in a wide selection of body materials, such as cast iron, cast steel, lead lined and glass lined. Bonnet assemblies operated by lever, diaphragm motor, cylinder, chain wheel or other methods may be obtained.



Corrosive Fluid Valve



Portable Pump Unit

Portable Pump Unit

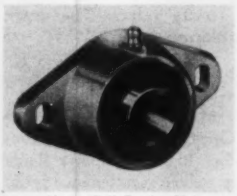
HPAC 19—Jabsco Pump Co., 2031 Lincoln St., Burbank, Calif., is offering a new close-coupled electric motor and pump unit, model 2187.

The pump unit consists of a bronze self-priming pump with a neoprene impeller and has ½ in. inlet and outlet ports designed to accommodate standard female hose couplings. It is mounted directly on the shaft of a ¼ hp. 1725 rpm. single phase, capacitor motor. Fitted with an 8 ft extension cord, the unit weighs 25 lb and will handle 10 gpm against a 10 ft head.

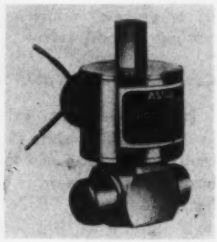
Ball Bearing Flange Unit

HPAC 20—The FED series ball bearing flange unit of Ahlberg Bearing Co., 3025 W. 47th St., Chicago 32, features a streamlined, all-metal, two-bolt style housing. It is designed for small shaft equipment where light loads and normal speeds are imposed.

Other features include internal self-aligning bearings designed to compensate for shaft deflections and mounting inaccuracies and a labyrinth-type seal for eliminating drag and undue wear. A headless set screw locks the unit to the shaft and a standard grease fitting is provided for supplementary lubrication.



Above: Ball Bearing Unit



Right: Solenoid Valve

Packless Solenoid Valves

HPAC 21—Automatic Switch Co., 379-C Lakeside Ave., Orange, N. J., has added a new two-way and a new three-way valve to its line of "Asco" packless solenoid valves. Because of their size, they are named "Midget" valves.

"Aw shucks, he has **snow melting**"

Steel pipe is first choice for snow melting

A boy, a dog and a snow shovel are an irresistible combination for loosening heartstrings as well as purse-strings! The first snow brings the tinkling of the doorbell and the piping query, "Want your snow shoveled, mister?" Often a shy companion lurks just out of vision, hoping to share this first youthful adventure in capitalism.

But even so time honored a money making opportunity must some day yield to the march of progress!

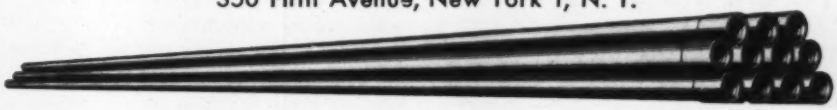
More and more, home owners are installing the ultimate snow-removal facilities . . . hot water circulatory systems embedded in the concrete sidewalks, driveways and service areas of their properties.

Steel Pipe is first choice, by far, for such installations . . . because Steel Pipe has all the desirable qualities of formability, weldability, durability, and economy required for successful snow melting systems.

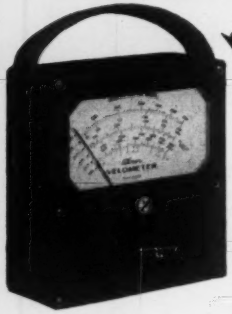
Driveways and garage aprons can be kept snow and ice-free at all times with a steel pipe snow melting installation.

Have you seen the new 48-page color booklet, "Radiant Panel Heating with Steel Pipe"? Write for your free copy now.

COMMITTEE ON STEEL PIPE RESEARCH
AMERICAN IRON AND STEEL INSTITUTE
350 Fifth Avenue, New York 1, N. Y.



Alnor
Velometer



gives instant, direct reading of Air Velocity . . . Anywhere!

Here is a precision-built, self-contained, portable instrument that gives instant, accurate reading of air velocities—anywhere. Measures speed of flow through ducts, grilles, motors, furnaces, etc., or in the open. Needs no calculations or reference charts. Anyone can use it and get accurate measurements. Available in a wide range of scales, and with a wide assortment of jets and fittings if needed. You'll want full details and prices, so write for Bulletin No. 2448-G. Illinois Testing Laboratories, Inc., Room 513, 420 N. La Salle Street, Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

They are designed to handle a wide range of liquids and gases at temperatures up to 212 F, and are recommended for use in equipment such as oil burners, measuring and testing apparatus, gas heaters, power cylinders and diaphragm motor controls.

Pipe sizes of the two-way valves are $\frac{1}{8}$ in. and $\frac{1}{4}$ in. (normally closed) and $\frac{1}{8}$ in. (normally open). Permissible pressures range up to 300 psi for a-c operation and up to 250 psi for d-c operation. Three-way valves are of the universal type, being applicable to any three-way requirement (regardless of the direction of flow or points of pressure application), and are available in the $\frac{1}{8}$ in. size only. The maximum allowable pressure is 125 psi for a-c operation and up to 50 psi for d-c application.

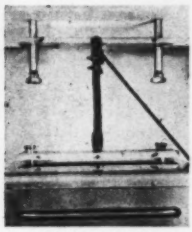
Stud Welding Power Units

HPAC 22—Development of two special power units, designed for use with its stud welding equipment, has been announced by Nelson Stud Welding Div., Morton Gregory Corp., Lorain, Ohio. One unit is a motor operated generator set capable of welding studs up to and including $\frac{5}{8}$ in. in diameter. The other is a battery operated unit which can be used for installing studs up to $\frac{1}{2}$ in. in diameter with the company's automatic stud welding gun.

The power unit is said to be equivalent to two conventional 400 amp generators in parallel, comparable in size to a 200 amp welding generator, and to weigh approximately 800 lb. Either 220 volt or 440 volt, 60 cycle current can be used with the new power unit.

The battery unit is recommended for construction jobs where welding generators or necessary power are not available, and for plant maintenance operations.

Stud Welding Power Unit



Unit Heater Hoist

Unit Heater Lift Assembly

HPAC 23—A new lift assembly for use in hoisting and lowering unit heaters is available from Reznor Mfg. Co., Mercer, Pa.

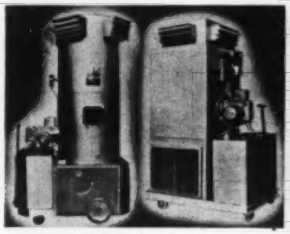
Said to cut installation costs and time by as much as 50 percent, the new lift assembly permits one man to hang the company's new 25,000 Btu "Cadet" heater and to enable two men to install other, larger company heaters quickly. The assembly brings heaters within 7 in. of the ceiling, and can be used with or without the 24 in. and 36 in. hanging boards, currently in the line. These boards now serve as anchors for hoisting heaters by block and tackle or electric hoist, and to finish the ceiling and supporting pipes in appearance.

The lift assembly can be used over and over for any type installation and may be used to lower and hoist heaters for cleaning purposes.

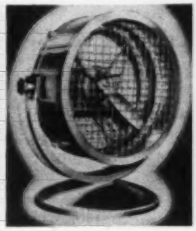
Portable Direct Fired Heaters

HPAC 24—The portable "Thermobloc" heaters of Prat-Daniel Corp., East Port Chester, Conn., are recommended for use on construction jobs, in quarries, and many other temporary applications. Mounted on a truck, each unit has its own attached fuel tank and may be moved about so as to provide the most effective diffusion.

In the illustration, the heater at the left provides 300,000 Btu per hr output, while that on the right is supplied in 100,000 and 200,000 Btu per hr ratings. The company also manufactures the model 1000, which is designed to provide 1,000,000 Btu per hr.



Portable Air Heaters



Propeller Fan

Redesigned Propeller Fan

HPAC 25—A complete redesign of its utility fan has been completed by Hartzell Propeller Fan Co., Piqua, Ohio.

An unusually large circular base of stamped steel is said to make the fan practically tip-proof, and a new fan supporting mechanism, welded to this base, grips the fan at each side and allows it to be turned vertically 360 deg. It can be locked at any position by means of hand operated friction screws.

Guards, designed to pass all safety codes, protect both the front and rear of the fan. The motor is outside the guard to facilitate oiling and inspection. The fan is made in various sizes which range from 14 to 36 in. in diameter.

Oil Burner

HPAC 26—An oil burner designed especially to burn catalytically cracked oils is now available from Nu-Way Corp., Rock Island, Ill.

Features are said to include a new type combustion head and a sturdy housing made of sand cast aluminum which forms the streamlined exterior. The model CO-2 unit is rated at 0.75 to 2 gph and the model CO-6 unit will handle from 2 to 6 gph. A large rear opening is provided for access to parts and an inspection port is used for checking the flame.

Temperature Indicators, Recorders

HPAC 27—The new line of thermocouple actuated "Microsen" temperature indicators and recorders of Manning, Maxwell & Moore, Inc., Bridgeport 2, Conn., has been designed to measure temperatures between −100 F and 3000 F.

Features include a power operated pointer, standard electron tubes, a full scale circular dial, rugged construction, and design simplicity. The balance principle incorpo-

Perfect Air Control with Ornamental Outlets

For air circulating systems in residences the dual-unit Hendrick Bulator is ideal. It provides complete control of air throw and spread, with a decorative effect that actually adds to the attractiveness of the room.

The installation shown is in the home of the president of a prominent corporation. Although the deflecting vane grilles of the Bulator are directly behind the Gothic Cloverleaf design of the ornamental grilles, only the latter are visible from the room.

For Bulator dual-unit installations a wide variety of ornamental grille designs are available, so one can readily be selected to harmonize with the decorative scheme of any room.

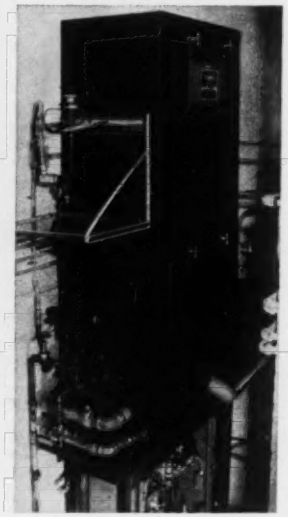
Write for full details on this practical dual-unit combination.

Perforated Metals
Perforated Metal Screens
Wedge-Slot Screens
Architectural Grilles
Mitco Open Steel Flooring,
Shur-Site Treads, Armorgrids

HENDRICK
Manufacturing Company
48 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

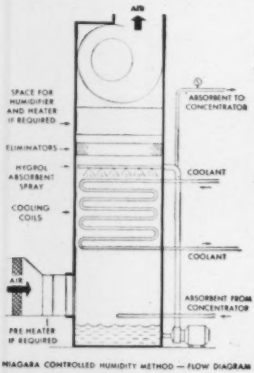
New "Controlled Humidity" Method Gives a Better Solution to Air Conditioning Problems

"Hygrol"
Absorbent
Liquid
Dehumidifies
Fresh Air
Without
Refrigeration



● NIAGARA Air Conditioners or Dehumidifiers using "Hygrol" liquid absorbent give precise control of air temperature and humidity . . . at lower operating cost, with large savings in space and with smaller and less expensive equipment, in many applications.

This method dehumidifies the air by passing it through a chamber in which "Hygrol" spray removes its moisture and produces a low dew point. The "Hygrol" solution resulting is continuously and automatically re-concentrated, providing always full capacity in air conditioning and assuring always a constant dehumidifying capacity and a trustworthy, constant condition for your material, apparatus, process or room to be conditioned.



NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

"Hygrol" is a liquid, not a salt solution; it stays pure and non-corrosive; does not cause maintenance or operating troubles in food plants or in chemical processes.

Investigate this new Method for "comfort" air conditioning as well as to protect quality in hygroscopic material, or processes or instruments, or to prevent condensation damage to metals, parts or products.

Write for Bulletin No. 112

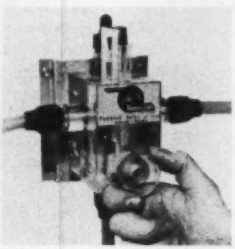
NIAGARA BLOWER COMPANY
Over 35 Years of Service in Industrial Air Engineering
Dept. HP, 405 Lexington Ave. New York 17, N. Y.
Experienced District Engineers in Principal Cities

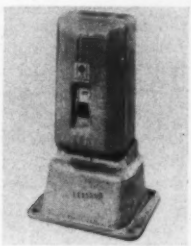
rated in these units is designed to produce a mechanical equilibrium between two forces. One force is proportional to the thermocouple input, the other is proportional to the mechanical position of the instrument pointer. The input force is established by the field of a coil connected to the thermocouple. Variations in this input force unbalance a small pivoted arm or beam. A movement of this beam changes the tuning of an oscillator circuit in the electronic section. This varies signal output which positions the pointer in ratio to the input being determined. Force is applied by the position of the pointer through a calibrated spring to offset the variation of the input force and rebalance the beam at the new signal level.

Chemical Feeder

HPAC 28—A new low cost, chemical feeder for eliminating destructive algae and slime in cooling towers is offered by Paddock Engineering Co. of Texas, Dallas, Tex.

Called "Sureclor", the feeder is water energized and operates on a high vacuum principle. The device is fabricated from transparent plastics so that operation is visible at all times. A manual setting of a control valve governs the amount of additive chemical being introduced. Main water supply line pressure activates the feeder, and part of the water in the supply line is diverted into the unit by creating a 50 percent difference in pressure. This diverted water passes through a restricted opening from the high pressure side to the low pressure side, a vacuum being created to draw the chlorine solution into the unit where it is mixed with the diverted water.


Chemical Feeder


Motor Starter

Motor Starter

HPAC 29—Protection of operating personnel as well as the connected machine is stressed in a new motor starter, the "Motor Watchman", class 10-100-S1, available from Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30.

With ratings up to 600 volts, 7½ hp polyphase; 5 hp single phase; or 220 volts, 1½ hp d-c, it starts, stops, and provides overload protection.

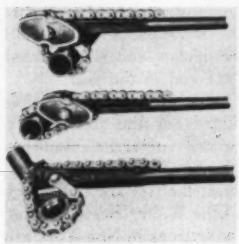
The self indicating handle, an interlocked cover (to prevent opening unless the starter is "off"), and a safety latch to lock the starter "off" during servicing are some of the features.

Positive motor protection, says the company, is provided by the quick-make, quick-break, over-center toggle mechanism, the use of de-ion arc quenching, and the bimetallic, disc type thermal overload relay. Straight-through wiring is used to facilitate installation and servicing.

Reversible Pipe Tongs

HPAC 30—Without removing the tongs or loosening the chain, the new "Vulcan" reversible tongs will turn pipe in either direction. The manufacturer is J. H. Williams & Co., 400 Vulcan St., Buffalo 7, N. Y.

For use on narrow beads and flanges, the outer jaws can be removed by taking out the single standard bolt and nut used in assembly. These outer jaws are also reversible, end for end. The tongs are available in four sizes for pipe and fittings from ¼ to 8 in. In the illustration, the tongs are arranged (respectively from top to bottom) for making up joints, for breaking out, and for use on various fittings.



Pipe Tongs

Small Humidifier

Small Humidifier

HPAC 31—A new "heavy duty all purpose" humidifier, a small version of its large industrial "Hum-O-Zone", is now in production at the plant of Daffin Mfg., Co., Lancaster, Pa.

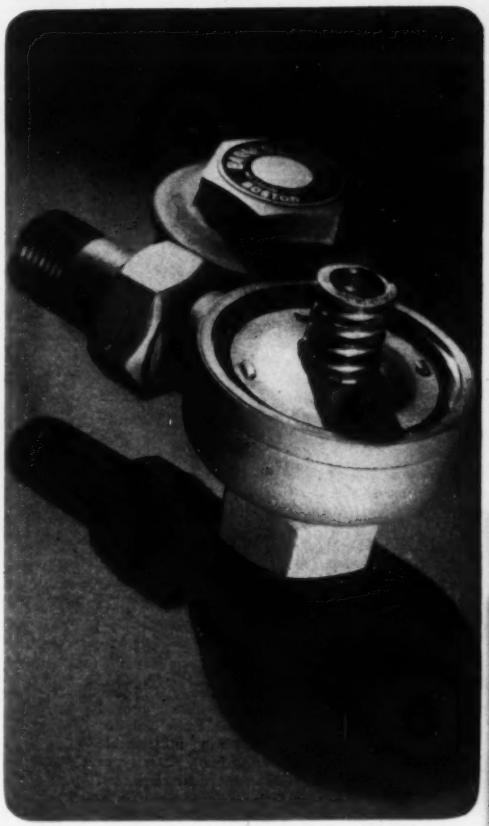
This small humidifier is a table model type especially designed for use in hatcheries, egg storage rooms, cold storage rooms and compartments, chemical plants, textile mills, and other places where a lack of proper humidity is harmful either to personnel or materials being handled.

Output of this new unit, which measures 9 in. across and 5 in. high, is 2-½ lb per hr of water. The device contains an automatic float valve and may be adapted for automatic control.

WE HEAR THAT . . .

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has acquired *WINTROATH PUMPS, INC.*, Alhambra, Calif., which will be operated as a wholly owned subsidiary, continuing under the present management.....*NATIONAL RADIATOR CO.*, Johnstown, Pa., has purchased the Danville, Pa., steel fabricating plant of Webrib Steel Corp., New York City, to handle its expanded defense activities. The acquisition gives the company nine plants in six locations.

A certificate of honor was recently presented to *LEO C. RUDEGEAIR*, chairman of the safety committee at the Middletown, Pa., plant of *NATIONAL RADIATOR CO.*, Johnstown, Pa. The certificate, presented by *BENJAMIN F. SELLERS*, of the Commonwealth of Pennsylvania, Department of Labor and Industry, was awarded in recognition of the Middletown employees having completed a year's operations without a single accident causing lost time from work. This plant also received recently a plaque from the National Safety Council for its record.



This Trap Makes a Habit of Real Thrift

Built to last, a B&J Trap is a miser on maintenance. The cage unit is a complete operating unit in itself, containing the thermostatic element, valve piece and trap seat accurately calibrated in exactly correct relation to each other before it leaves our factory . . . and locked in permanent, unalterable adjustment. This reflects in real savings on repair and maintenance problems after installation.

Yes, when you select Barnes & Jones heating specialties in the beginning, you never have regrets in the end!

B&J

BARNES & JONES, Inc.

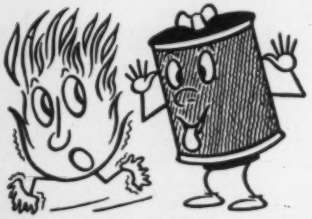
128 BROOKSIDE AVENUE, BOSTON 30, MASS.

Representatives in all principal cities

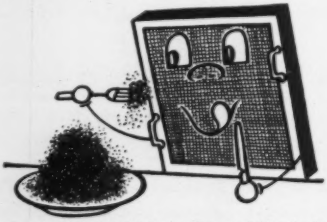
AIR-MAZING FACTS

BY O. SOGLOW

FEEL A DRAFT? In order for air in motion to be called a draft it has to be moving at a speed of at least 3.5 feet per second. Authorities say that the average person can't detect air in motion unless it's moving that fast.



GIVE FLAMES COLD FEET! Air-Maze approved flame arresters keep sparks, flame and dirt out of tanks used for storing inflammable liquids. Another of the many filter types designed by Air-Maze, the filter engineers.



DIRT'S ITS DISH! Airborne dust and dirt don't get very far with Air-Maze filters on the job. Air-Maze filters provide clean air for ventilation systems, keep damaging dust out of engines, compressors, blowers, electronic equipment, motor generator rooms, etc. All-metal, cleanable, high dirt-holding capacity.

WHETHER YOU BUILD OR USE engines, compressors, air-conditioning and ventilating equipment, or *any device using air or liquids* —the chances are there is an Air-Maze *engineered* filter to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.

AIR-MAZE

The Filter Engineers

AIR FILTERS
SILENCERS
SPARK ARRESTERS

LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

WESTINGHOUSE ELECTRIC CORP., Pittsburgh, is building a new plant for the production of small electric motors in Union City, Ind. Production is expected to start late this year. The company's small motor division has leased two additional buildings in Lima, Ohio. These will be used to produce parts needed at the company's main Lima plant for military production and will also be used for office and storage use.

Attendance at the traveling Parade of Progress road exhibit of *MINNEAPOLIS-HONEYWELL REGULATOR CO.* has exceeded expectations, according to reports from the first 10 cities in the eastern and mid-Atlantic region where it has appeared. More than 7500 architects, engineers, school and hospital administrators and transportation technicians have seen the show which includes 38 working models of control instruments and is scheduled to visit some 60 cities before the end of the year.

Two more localities are slated for the free factory training school sessions presented at various colleges under the sponsorship of *PERFEX CORP.*, Milwaukee. Classes will be held this month at the Newark College of Engineering, Newark, N.J., and the Walter Hervey Junior College, New York City. Other sessions in New York are to be scheduled next month. The course includes instruction in the fundamentals of heating, including the operation, installation, and servicing of automatic controls.

TUBE TURNS, INC., Louisville, has appointed *BETHLEHEM SUPPLY CO.*, Tulsa, Okla., and *BETHLEHEM SUPPLY CO. OF CALIFORNIA*, Los Angeles, distributors of its welding fittings and flanges. The Tulsa organization is a subsidiary of Bethlehem Steel Co. and the Los Angeles firm is a subsidiary of Bethlehem Pacific Coast Steel Corp.

STURTEVANT DIV., WESTINGHOUSE ELECTRIC CORP., Hyde Park, Boston, Mass., has named *CLEVELAND AIR CONDITIONING CORP.*, 3030 Euclid Ave., Cleveland 15, distributor in the greater Cleveland area for its line of packaged air conditioners. The firm will specialize in industrial and commercial installations and is headed by *LEONARD F. AUERBACH*, a veteran of many years in the air conditioning field.

VIKING COPPER TUBE CO., Cleveland, has been able to control grain size to a tolerance of ± 0.05 mm since the installation of an all-electric annealing furnace. Designed and manufactured by *GENERAL ELECTRIC CO.*, Schenectady, N. Y., the roller-hearth furnace is used for annealing seamless copper tube. The furnace may be changed from annealing 30 ft lengths to small diameter coils or from short straight lengths to large diameter coils. It has handled 3000 lb per hr. of copper tube.

The No. 2 continuous weld pipe mill placed in operation last June by *YOUNGSTOWN SHEET AND TUBE CO.* in its Indiana Harbor plant utilizes two rotary straighteners manufactured by *MACKINTOSH-HEMPHILL CO.*, Pittsburgh. These machines will straighten 15,000 tons of from 1½ to 4 in. butt weld steel pipe in an 18-turn per week monthly production schedule. Handling pipe in lengths up to 46 ft, these crossed-roll

straighteners have been a definite factor in the high production and quality records established.

GENERAL CONTROLS CO., Glendale, Calif., recently inaugurated a new kind of television program in southern California. The first in a series of industrial success stories and sponsored by *RICHFIELD OIL CORP.*, the show was beamed at 800,000 set-owning families and took the audience through the company's plant. Television plant tours scheduled for subsequent weeks include those of *U. S. STEEL CO.*, *GOODYEAR RUBBER CO.*, and other southern California industrial organizations.

RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, has purchased a 60 acre plot in Euclid. To cost in excess of $1½ million, a new expansion project involves construction of a one story building, similar to a plant of approximately the same size built by the company in Ashtabula four years ago. It will be used for the manufacture of industrial type motors and accessories and, in addition, will house the company's engineering, development, research and renewal parts departments.

FLEXITALLIC GASKET CO., Camden, N. J., has added three new distributors and two new agents to its field organization. The distributors are: *TATE ENGINEERING & SUPPLY CO., INC.*, Baltimore, Md., serving Maryland and Washington, D. C.; *A. L. CRUMP & CO.*, Chicago, covering northern Indiana and Illinois; and *SOUTHERN MARINE SUPPLY CO., INC.*, Savannah, Ga., serving the marine industry within the limits of Savannah. The two new agents are: *CARL GRIMES & CO.*, Des Moines, Ia., handling western Iowa; and *FRANK VALETTI & CO.*, Philadelphia, serving the marine industry within the limits of Philadelphia.

A. L. CRUMP & CO., Chicago, is now the sales representative for industrial heating equipment of *CARRIER CORP.* and will cover the Chicago area.....*AIR REDUCTION SALES CO., DIV. of AIR REDUCTION CO., INC.*, 60 E. 42nd St., New York 17, has prepared a 16 mm sound motion picture in color which tells the story of the new "Aircomatic" process for welding aluminum, stainless steel, bronze and monel.

The film, with a running time of 21 min., was prepared for showings to nontechnical as well as technical groups. Further details and information on making arrangements for showing the movie may be obtained from the company.

At the recent 19*th EXPOSITION OF POWER AND MECHANICAL ENGINEERING*, attendance totalled 32,000, with visitors registered from every state of the union and many foreign countries. The show was presented under the auspices of the *AMERICAN SOCIETY OF MECHANICAL ENGINEERS* and was held in conjunction with its annual meeting.

BLUE SEAL ASBESTOS CORP., Brooklyn, N. Y., one of the oldest fabricators of insulating parts in the country, has been purchased by *CARL H. KRAUSE*, who will function as its president. Until recently, Mr. Krause was New York works manager for Trumbull Electric Mfg. Co.

2 ways to CUT assembly costs!

DRILL IT! with a B & D HOLGUN. Drills holes to ¼" diameter in steel to ½" in hardwood.

DRIVE IT! with a B & D SCRUGUN. Drives machine screws and nuts to ¼", self-tapping screws to #12, wood screws to #10 x 2". Positive or adjustable clutch available.

B & D HOLGUNS*, SCRUGUNS* give you MORE WORK

Per MAN These Tools are perfectly balanced, weight saving, compact, with famous "Pistol Grip and Trigger Switch". Accurate and easy to handle. Help your men produce more, with less fatigue and less work spoilage.

Per HOUR Abundantly powered by B&D universal motors, they have full power and speed for continuous use—help you do more sheet metal assembly per hour, *every* hour!

Per TOOL These Tools give you *extra* years of service! Extra-tough gears, shaft and chuck spindle, powerful motors, husky housings are *built to last!*

WRITE TODAY for free, detailed catalog to: THE BLACK & DECKER MFG. CO., 628 Pennsylvania Ave., Towson 4, Md. *Trade Mark Reg. U. S. Pat. Off.

LEADING DISTRIBUTORS EVERYWHERE SELL

B&D Black & Decker PORTABLE ELECTRIC TOOLS

ELECTRIC SHEARS | ELECTRIC SANDERS | BENCH GRINDERS | "WHIRLWIND"® WIRE BRUSHES

Graduate

ENGINEERS

GOOD OPPORTUNITIES for

POWER ENGINEERS: Must have five to fifteen years experience in some of the following: operating, testing and maintaining power plant equipment, supervising power plant operations, making cost and evaluation studies, heat balance work, power cost accounting, design and layout of power plants, and the selection and installation of power equipment. Must be graduate.

AIR CONDITIONING ENGINEERS: At least 7 years' experience in selection and operation of heating, air-conditioning, ventilating and refrigeration equipment. Well versed in the theory of thermodynamics, fluid flow and heat transfer. For consulting evaluation, and economic operation services. Must be graduate.

MAINTENANCE ENGINEERS: Five to ten years in planning maintenance work, establishing manpower and material requirements, scheduling and controlling work. Must be thoroughly familiar with Machine and Hand Tools used in Plant Maintenance Work. Must have supervised persons doing maintenance work. Must be graduate. For consultation work.

HEATING AND VENTILATION ENGINEERS: Eight to ten years progressively difficult experience in field and office problems in heating, ventilating and air-conditioning design. Also, experience in making economical evaluation of alternate methods. Must be graduate.

Give experience, education, age, references, personal history, salary received and salary expected. Please be complete and specific.

All inquiries will be considered promptly and kept confidential.

E. I. du Pont de Nemours & Co. (Inc.)

Engineering Department Personnel

Wilmington 98, Delaware.

Preliminary plans for erecting a new, modern single story building in Bellwood, Ill., have been announced by *UNISTRUT PRODUCTS CO.*, Chicago. The first unit of the new structure will provide general offices, permanent sales and display showrooms, and a warehouse and will be built as soon as conditions permit.

BROWN INSTRUMENTS DIV., MINNEAPOLIS-HONEYWELL REGULATOR CO. is expanding its industrial production and operating facilities in Philadelphia. The Thomas M. Royal plant has been purchased and the company has also acquired about 60,000 sq ft of adjacent undeveloped property. This expansion in Philadelphia is the second in less than two years.

Customer employee courses fitted to the specific requirements of its industrial instrument users began last month at the Philadelphia school of the Brown Division. Courses will cover industrial instruments maintenance and repair and classes will be held on a 3, 5, and 13 week basis. The shorter courses will be for concentrated instruction, the longer courses for more comprehensive training. The remaining three-week courses start on March 26 and April 30. The five-week classes start February 12 and May 28 and the comprehensive-thirteen-week course will be held from February 12 to May 11th.

The division is asking customers to submit details covering the application of nonindicating industrial control devices on specific and knotty processing and maintenance problems. Each month eight to 10 awards will be made to those users of products who submit outstanding ideas. The awards will be based on general usefulness of the ideas in promoting more widespread economy, quality and other advantages. Each winner will receive a "Chronotherm" thermostat and the winning ideas will be published in monthly bulletins.

This year marks the 75th year of business of *SAUER, INC.*, Pittsburgh, one of the country's oldest firms in the field of mechanical contracting. Headed by *WILLIAM N. STEITZ*, president, and with a personnel of some 350 employees, the company has done piping, heating and ventilating work in many of Pittsburgh's large buildings.

A new sprinkler stopper, essentially a wedge with a three-layer rubber diaphragm, is offered by *SPRINKLER STOPPER CO.*, 170 S. Van Brunt St., Englewood, N. J. Designed to stop property damage by water from sprinklers after a fire has been extinguished or in case of mechanical failure, the stopper fits on the end of a short pole and is inserted into the "ring" of the sprinkler so as to shut off the water at the point of flow. The diaphragm covers the outlet, pressure being maintained by a spring in the assembly.

Due to an error in HPAC's 1951 directory of heating, piping and air conditioning equipment, Iron City Chemical Co., Evans City, Pa., is omitted, on page 80d, under the heading Units, Sterilizing, Air. The firm is incorrectly shown under the heading immediately above.

WHO'S WHAT

CHARLES E. WILSON, who is now chairman of the *DEFENSE MOBILIZATION BOARD*, has been succeeded as president of *GENERAL ELECTRIC CO.*, Schenectady, N. Y., by *RALPH J. CORDINER*, executive vice president and a director of the company since 1949. In the company's air conditioning department, *W. F. R. KARSTEN* is now supervisor of commercial engineers. He has been associated with the department since its inception in 1932, and in 1943 was made division sales manager with headquarters in Bloomfield, N. J. *ROBERT L. GIBSON* with headquarters in Pittsfield, Mass., is now managing the chemical department. He had been assistant general manager.

ALLEGHENY LUDLUM STEEL CORP. has elected *EDWARD J. HANLEY* president, and *CLARK W. KING* executive vice president. Mr. Hanley, presently serving as executive vice president, succeeds *E. B. CLEBORNE* who has resigned. Mr. King is now vice president and treasurer. He succeeds Mr. Hanley and retains the position of treasurer. Mr. Cleborne continues as a director and vice president. Other personnel changes include the retirement of *FRANK B. LOUNSBERRY* as vice president and technical director and the appointment of *W. B. PIERCE*, presently manager of the sales development and engineering service department, as technical director.

PAUL M. ARNALL has been elected president of *LUNKENHEIMER CO.*, Cincinnati, and succeeds *FRANK P. RHAME*, who has resigned after 32 years of service, but who will continue as a director and in an advisory and consulting capacity. Mr. Arnall joined the firm a year ago after resigning as executive vice president of Ohio Injector Co.

THE TRANE CO., La Crosse, Wis., has elected *R. E. LUCEY* and *H. C. ROOKS* vice presidents and has named *E. A. CLINE* sales manager. Mr. Lucey continues as manager of product development and chairman of the company's development committee. Mr. Rooks joined the firm in 1933 and is a heat transfer specialist. *R. E. HASKINS* succeeds Mr. Cline as manager of convector-radiator sales.

JOHN C. KOCH, who joined *CONOFLOW CORP.*, Philadelphia, in 1945 and has been general sales manager, is now vice president in charge of sales.....The new vice president in charge of sales for *LINCOLN ELECTRIC CO.*, Cleveland, is *W. R. PERSONS*. He has been general sales manager since 1946.

The new director of the west coast research and development laboratory of *ROBERTSHAW-FULTON CONTROLS CO.* is *H. W. GEYER*, who is well known for his many years of service with the Southern Counties Gas Co. of California. He has served on a number of American Gas Association committees and is the author of many technical papers and reports. He succeeds *S. G. ESKIN*, who has been transferred to the executive offices of the company in Greensburg, Pa., to serve in the capacity of technical advisor.

These EXTRA Airsan Features Mean EXTRA Filtering Efficiency

GALVANIZED STEEL FRAMES

FULL BRONZE WELDED CORNERS

DRAIN SLOTS FOR QUICKER, EASIER CLEANING

EXPANDED METAL FACE PLATE

Media of Airsan Air Filters is viscous type, permanent and cleanable. Constructed of multiple layers of galvanized wire mesh, media is designed to give maximum efficiency plus large dust holding capacity at low resistance. Expanded metal face plate acts as lint arrestor — distributes air evenly over entire filtering area, and aids in easier cleaning and servicing.

Available in standard 1" and 2" thickness, or for industrial and special applications in 2" to 4" thickness. Holding frames for all type filters for V type or straight banks.

SEND FOR THESE BULLETINS

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Air Filter Corporation

108 F North Water St., Milwaukee 2, Wis.

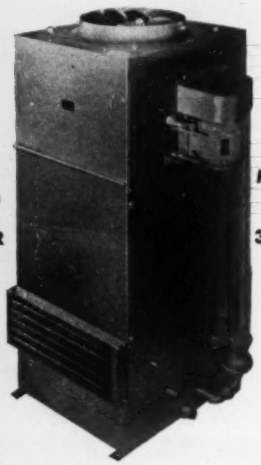
Canadian Representative

DOUGLAS ENGINEERING CO., LTD. MONTREAL

Introducing

The New B A C Series "P" Units

TO SOLVE YOUR WATER SHORTAGE PROBLEMS



Model "P" Evaporative Condensers 3 to 100 TR Freon — Ammonia

Model "PT" Cooling Towers 3 to 100 TR

New Features • Compact Design • Outdoor Installation

- Mono-Drive saves space, simplifies control, affords economy of installation. Separate pump motors available.
- No oiling required . . . motor, pump and fan bearings pre-lubricated for life.
- Vertical pumps drain automatically when pan is empty.
- Motor 95% enclosed . . . special tropical insulation for outdoor use . . . rain guard over motor and drive.
- Large, slow speed, quiet operating fans . . . lower horse power requirements.

For further information write to —

BALTIMORE AIRCOIL CO., INC.

2519-23 Pennsylvania Ave. • Baltimore 17, Md.

—Specializing in Water-Saving Devices Since 1938—

JOHN M. KANE, who joined *AMERICAN AIR FILTER CO., INC.*, Louisville, Ky., in 1933 and was made chief engineer of its dust control division in 1944, is now manager of the division.....Officers of the *NATIONAL WARM AIR HEATING & AIR CONDITIONING ASSOCIATION*, who were recently nominated and unanimously elected for a second term are: president — *C. S. FRANKE*, president, American Furnace Co.; first vice president — *W. D. REDRUP*, chairman of the board of Majestic Co.; second vice president — *C. B. PHILLIPS*, vice president of Surface Combustion Corp.; and managing director and secretary-treasurer — *GEORGE BOEDDENER*.

After a 20 month period during which he served as director of foreign affairs for Kuljian Corp., *F. L. YETTER* has rejoined *C. H. WHEELER MFG. CO.*, Philadelphia, as senior vice president. He has long been associated with the power plant field and began his long tenure of service with Wheeler in 1916. As previously announced, the company is now a division of *HAMILTON-THOMAS CORP.*

L. A. CASLER, long associated with the oil heating equipment industry, has been named executive vice president of *EUREKA WILLIAMS CORP.*, Bloomington, Ill., and manager of its Williams Division. He is also a member of the corporation's board of directors..... *THOMAS D. JOLLY*, vice president in charge of engineering and purchases for Aluminum Company of America since 1942, has been elected to fill his third one-year term as president of the *AMERICAN STANDARDS ASSOCIATION*. The ASA is made up of 101 technical societies, trade associations, and consumer groups, and 1800 individual company members.

The grade of Fellow in the *AMERICAN SOCIETY OF MECHANICAL ENGINEERS* has been awarded *THOMAS A. MARSH*, national industrial engineer for Iron Fireman Mfg. Co. This is the second major honor accorded Mr. Marsh, who in 1945 received the Percy Nicholls Award, given for notable scientific or industrial achievement in the field of solid fuels.

FRANK HALLBERG is the recently named chief engineer for *ROSS OPERATING VALVE CO.*, Detroit. He has had wide experience in the development of machine equipment and brings extensive knowledge of pneumatic and hydraulic applications to his new position.

FRANK E. HUTTON has been named to the position of executive assistant in charge of the application and sales of heat and chemical recovery equipment, digesters, alloy castings, and other process equipment for the pulp and paper industry by *BABCOCK & WILCOX CO.*, New York. He joined the company in 1927 as an apprentice engineer, later becoming a member of the Pittsburgh sales staff. He was loaned to the government during World War II, and joined the New York office five years ago.

ROBERT C. BLACK, formerly on the staff of the vice president of Westinghouse Electric Corp. and formerly advertising and sales promotion manager for the south-

eastern district of Westinghouse, is now advertising manager of the machinery division of *DRAVO CORP.*, Pittsburgh. The division includes the company's heating, ventilating, air conditioning, power plant piping and heavy industrial equipment departments.

CAPT. DAVID R. HULL, USN (Ret.), has been elected a vice president of *RAYTHEON MFG. CO.*, Waltham, Mass. He had been assistant manager of the company's equipment division and replaces *WALLACE L. GIFFORD* as manager of the division. Mr. Gifford continues with the company as a director and vice president in an advisory capacity.

BABCOCK & WILCOX CO., New York, has named *S. T. MACKENZIE*, head of the Philadelphia office, to the newly created post of sales manager, and *R. W. BUNTIN* has taken over his former position. ..... *CHARLES L. FOSS* has joined the staff of *UNITED STATES AIR CONDITIONING CORP.*, Minneapolis, as assistant to *A. A. FEINBERG*, president. He was formerly associated with the Bankers Trust Co. of New York and the equipment manufacturing division of Air Reduction Co., Inc.

WILLIAM G. MAHLMAN, for three years supervisor of order analysis for both Edward and Nordstrom valves, has been promoted to sales office manager of *EDWARD VALVES, INC.*, East Chicago, Ind. He succeeds, *HERBERT J. ROWE*, who has been called back to the U. S. Marine Corps.

Working with the cooperation of the construction section of the National Safety Council, the *NATIONAL CONSTRUCTORS ASSOCIATION* is setting up a nationwide program aimed at reducing the frequency and severity of lost-time accidents. *F. R. GRIFFIN*, safety engineer for the engineering and construction division of Koppers Co., Inc., has been elected chairman of the association's safety committee.

JOHN ADAMS KUNEAU has been named director of public relations for *PHILCO CORP.*, Philadelphia, and its subsidiaries and has been named to the firm's management operations committee. He was formerly vice president of the J. Walter Thompson Co., advertising agency, and prior to that had been president of his own public relations firm in New York City.

The newly elected president, *ARTHUR VORYS*, of the *NATIONAL HEATING WHOLESALERS ASSOCIATION, INC.*, has appointed the following War Emergency Liaison Committee: *CHARLES BIRD*, of Cincinnati Supply Co., chairman; *HARRISON SOMERVILLE*, of Thos. Somerville Co.; and *JOHN PHILLIPS*, of Stelwagon Mfg. Co. Mr. Vorys, of Vorys Bros, Inc., is an ex-officio member of the committee.

PAUL J. LARSEN, formerly director of the Office of Civil Defense of the National Security Resources Board, has been named assistant to *ROY C. INGERSOLL*, president of *BORG-WARNER CORP.*, Chicago. ..... The new service manager of the *DELCO APPLIANCE DIV., GENERAL MOTORS CORP.*, Rochester, N. Y., is *RICHARD T. REDDINGTON*, who joined the division

POPULAR
PARTS
..... All accessories on Olson Heaters are of the best name and quality known to heating engineers. They are standard products of nationally known manufacturers. Replacements are available anywhere.
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ARTHUR A. OLSON & COMPANY
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DIRECT FIRED HEATERS
Gas, Oil, Coal
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IN STOCK for Your Convenience

AURORA
CLOSE-COUPLED
Package

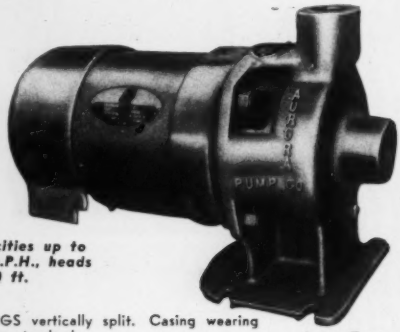
AIR CONDITIONING PUMPS

They have EVERYTHING!

- LOW COST
- LONG LIVED
- SMOOTH, QUIET
- MECHANICAL SEAL
- DEPENDABLE
- DISASSEMBLY is QUICK and SIMPLE*

for
EVAPORATOR COOLING TOWERS
•
AIR CONDITIONING UNITS
•
also for
GENERAL SERVICE

Air conditioning contractors as well as manufacturers of air conditioning equipment will welcome these notable close-coupled package pumps. Mechanical seal requires no packing or maintenance. *Pump may be disassembled without disturbing discharge connections or hold down bolts. Sturdy, lasting and efficient.



Capacities up to 150 G.P.H., heads to 100 ft.

Aurora Type JMC Pump — Close-Coupled

CASINGS vertically split. Casing wearing ring standard.

MECHANICAL SEAL is standard on all sizes and located in packing cover.

IMPELLER is balanced, of enclosed type, high grade bronze.

MOTOR — NEMA specifications, Stainless Steel Shaft on JMC — for all circuits and various enclosures.

BALL BEARINGS — on JMC built into motor.

OTHER AURORA AIR CONDITIONING UNITS

We are also in a position to supply various sizes of air conditioning pumps in V-Belt drive, and flexible coupling drive. Our large type G.M.C. Close-Coupled Pumps can be furnished up to 800 G.P.M. and heads to 200 ft.

Complete Information on Request

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS

AURORA PUMP COMPANY

80 Loucks St., Aurora, Illinois

in 1939 and has specialized in service work since that time. He succeeds *KENNETH O. WOLCOTT*, who has retired after 37 years of service with Delco Appliance and its predecessor companies.

As the new manager of the Detroit district office of *ALLIS-CHALMERS MFG. CO.*, Milwaukee, *N. W. LANDIS* has succeeded *F. S. SCHUYLER*, who has retired after 43 years of service. Mr. Landis has been manager of the company's Syracuse office since 1946, and is succeeded in that post by *A. J. MESTIER, JR.*, a sales representative in the New York district office since 1948.

C. CARLISLE TIPPIT, manager of the order and planning dept. of *RELIANCE ELECTRIC & ENGINEERING CO.*, Cleveland, since January 1948, is now general purchasing agent of the firm. *WALTER H. BEHNKE*, in the company's applied engineering department since 1945, has taken over his former post.

OTTO A. WENDT has been re-elected for a fourth term as president of the *VENTILATING & AIR CONDITIONING CONTRACTORS ASSOCIATION OF CHICAGO*. Other officers elected include *J. J. HAINES*, vice president; *P. W. OLMEN*, secretary, and *PORTER R. WEST*, treasurer. *H. JAMES MURRAY*, chairman, *WILLIAM A. KUECHENBERG, DAN SCHNEIDECKER* and *LOUIS L. NAROWETZ* were again named members of the arbitration board and also continue as association representatives on the board of directors of the *BUILDING CONSTRUCTION EMPLOYERS ASSOCIATION OF CHICAGO, INC.*

PETER V. CHELI is managing the Chicago branch office of *BRYANT HEATER DIV., AFFILIATED GAS EQUIPMENT, INC.*, Cleveland. He succeeds *WILLIAM H. WISE*, who has joined the home office organization as assistant to *J. N. CRAWFORD*, director of sales. Mr. Cheli became associated with the gas industry in 1934 when he joined the sales organization of Peoples Gas Light & Coke Co., of Chicago. During World War II he served with the War Production Board and later with the War Assets Administration. He joined the company in August 1949.

PYLE-NATIONAL CO., Chicago, has named *CHARLES H. HOBBS*, formerly of the Hobbs Western Co., a district manager with headquarters in St. Louis. He will handle both railroad and industrial sales in Missouri, Kansas, Arkansas, southern Illinois, and southern Indiana. . . . . *KENNETH E. LATIMER* has been elected treasurer of *REMINGTON CORP.*, Auburn, N. Y. He joined the company as chief accountant in 1947.

JOHN MOSES, who, for the last three years, has been a factory engineer specializing in room air conditioner manufacture with Carrier Corp., is a new Remington factory engineer. *JOHN E. SCHROEDER* is managing the newly established materials department of the air conditioning division. He had previously been planning supervisor of Carrier Corp., planning chief of Adam Opel A. G., German subsidiary of General Motors Corp., and had also been planning supervisor of Continental Motors Corp. *ROLLAND J. KAUSSNER* has been promoted to Remington purchasing agent.

ALFRED E. BAKANOWSKI has joined the research staff of *PITTSBURGH CORNING CORP.*, Pittsburgh. He will be awarded his Ph. D. degree in physics from Brown University next June. *ROBERT E. SCHREINER* has also joined the company's research staff, after having completed three years as research assistant at the thermal laboratory of the Engineering Experimental Station, Pennslyvania State College. Both men are working in the physics section of the laboratory in Port Allegany, Pa.

SERVEL, INC., Evansville, Ind., has appointed *HERMAN GOLDNER CO., INC.*, 425 W. Lehigh Ave., Philadelphia, wholesale distributor of its all-year air conditioning equipment. ..... *MADDEN BRASS PRODUCTS CO.*, Chicago, has named *GULLATT CO.*, 66 Mangum St., N.W., Atlanta, Ga., southeastern representative to serve the states of North and South Carolina, Georgia, Florida, Alabama, and the eastern half of Tennessee. *HENRY W. GULLATT* is president of the firm.

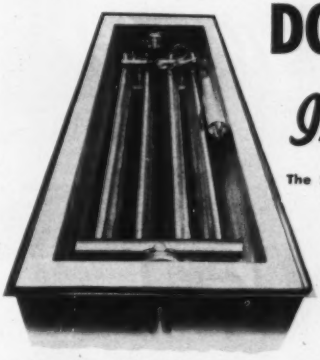
MELVIN W. GELBER has opened a consulting engineering office at 222 Coolidge Ave., Hasbrouck Heights, N.J. He will specialize in the design of radiant heating and air conditioning systems..... *JAMES W. BROOKS* has been transferred from the Boston office of *LINCOLN ELECTRIC CO.*, Cleveland, and is now in charge of the Indianapolis district. *THOMAS L. DEMPSEY* has been added to the company's sales staff as a special field engineer, and *JOHN F. KOTCHIAN* is now serving accounts in the Chicago district.

JACK TRAWICK, well known in trade circles, has been named representative for *BARBER-COLMAN CO.*, Rockford, Ill. His new office is located at 514 S. 47th St., Birmingham, Ala. ..... *S. C. McCANN* has been appointed sales representative in Kansas and western Missouri for *NATIONAL RADIATOR CO.*, Johnstown, Pa. His headquarters is at 1004 Baltimore St., Kansas City, Mo. *LAWRENCE E. SHEA* has joined the company's Pacific branch sales staff. With headquarters at 681 Market St., San Francisco, he is responsible for the sales of equipment in the San Francisco Bay area and in northern California.

REMINGTON AIR CONDITIONING DIV., REMINGTON CORP., Auburn, N. Y., has named *HARRY S. TRAYNOR* as co-ordinator of military business. In his position as staff assistant to the president, he is responsible for the application to military uses of standard company products as well as the utilization of a portion of the company's manufacturing facilities for the production of special products for military use. He was formerly with Carrier Corp. and during the war was an officer on the staff of General L. R. Groves at Oak Ridge, Tenn.

Recent additions to the staff of *SOUTHERN HEATER CO., INC.*, New Orleans, manufacturers' agent and distributor, include *H. N. STALL*, formerly with Minneapolis-Honeywell Regulator Co.; *J. I. HEBERT*, formerly with Shell Oil Co. and Balfour & Hebert, civil and consulting engineers; and *JAMES COLEMAN*, formerly with The Trane Co.

AIR CONDITIONING?



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SAVINGS with ICE-CEL vs. CONVENTIONAL DIRECT EXPANSION SYSTEMS

Daily Hours of Use	Compressor Size Reduction	Initial Savings
2 hrs.	10 to 1	50%
4 hrs.	10 to 2	35%
6 hrs.	10 to 3-1/3	20%
8 hrs.	10 to 4	10%

In addition to the savings in compressor investment, additional economies are possible in reduced size of cooling tower and in lower off-peak electric power bills. **Write for Engineering Bulletin 8-ES.**

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NEW BOOKS & REPORTS

Gives Comprehensive Data on Fuels and Combustion

Fuels and Combustion Handbook is an unusually comprehensive reference on the properties, characteristics and uses of all solid, liquid and gaseous fuels. It is edited by Allan J. Johnson, consulting mechanical engineer, and the associate editor is George H. Auth, professor of mechanical engineering, Villanova College. Compiled with the cooperation of over 450 authors and copyright owners, the book was prepared for practicing engineers and all others having an interest in the selection or use of any type of fuel.

Basic types of combustion of the various fuels are discussed in detail, as are pertinent types of combustion equipment. Such corollary factors as heat balances, smoke prevention, and draft requirements are covered in detail. A special feature of the handbook is the wide use of the rapid computation technique of alignment charts, replacement of formulas by tables and graphs wherever possible, and broad use of comparative tables to show advantages, disadvantages, salient features, applications, average performance data, etc.

Many new advances are covered, including those associated with synthetic fuels, the heat pump, gas turbines, spreader stokers, furnace and equipment designs.

The heat balance section is arranged for ready reference on three levels of accuracy and the smoke and fine particles section is unusually timely in view of the current and rapidly growing interest in air pollution.

The handbook is published by McGraw-Hill Book Co., 327 W. 41st St., New York 18, and is priced at $12.50.

Recommends Use of Lamé Formula In Piping Design

In the paper, Formula For Pipe Thickness, by W. J. Buxton and W. R. Burrows, of the Standard Oil Co. (Indiana), the so-called Lamé formula, either in its true form, or in an equivalent but less complex modified form, is advanced as the most suitable formula for the design of pipe that is stressed in the elastic range by internal pressure.

In the creep range, the use of the Bailey-Nadai formula is proposed, and it is shown that the so-called Lamé formula in either form is a good approximation of the Bailey-Nadai formula.

In the selection of these two formulas, an examination has been made of the common, average (membrane), Barlow, Clavarino, Guest, Beltrami, and von Mises formulas. The origin and meaning of all of these expressions are discussed. Their significance for design purposes is explained, and the relationship to the so-called Lamé formula is demonstrated. The need for additional pure shear experimental data on creep and on stress rupture is emphasized.

This paper, identified as No. 50-A-62, is the result of an investigation made as part of the work of currently revising the ASA B31 Code for Pressure Piping, Section 3, Oil Piping. It was presented at the recent annual meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

Establishes Uniform Methods of Conducting Sound Level Tests

The American Standard Test Code for Apparatus Noise Measurement, Z24.7-1950, is intended as a guide for those who use sound-level meters that meet the requirements of the American Standard, Sound-Level Meters for Measurement of Noise and Other Sounds, Z24.3-1944. It includes procedures for factory tests of equipment, field investigations, and sound-level specifications.

The section devoted to factory tests deals with the measurement of direct air-borne noise, reflected sound, ambient sound, apparatus mounting, location of microphone, (including tentative distances from the microphone for specific types of equipment), standing waves, record of measurements, and noise measurements.

For field investigations, the method of measurement of apparatus and ambient sound level, the difference between apparatus and ambient sound level, and the effects of environmental conditions are furnished.

A committee sponsored by the Acoustical Society of America under the procedures of the American Standards Association developed this standard. Among the industries represented are air conditioning, refrigeration, heating and ventilating, electric light and power. Copies may be obtained from ASA headquarters, 70 E. 45th St., New York 17, for 50 cents.

Short Course Emphasizes Importance of Instrumentation

For a number of years, A & M College of Texas has conducted instrumentation short courses on its campus to which personnel from the process industries are invited. The fourth short course, held in October 1949, emphasized the establishment and organization of instrument departments; however, sessions were also devoted to problems of special technical concern.

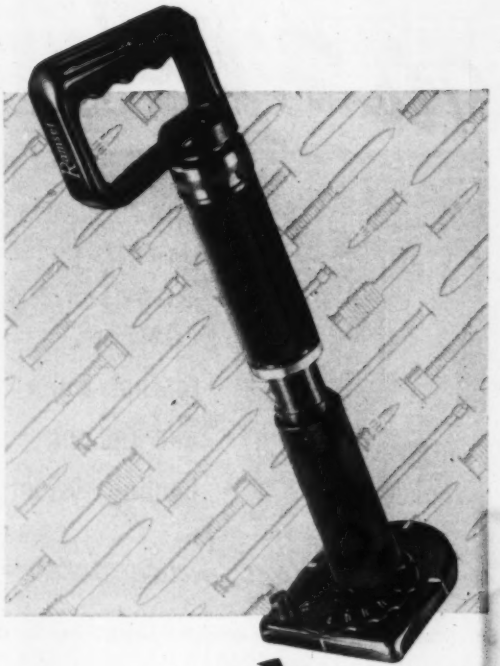
Bulletin No. 120, Fourth Annual Short Course on Instrumentation for the Process Industries, contains the following papers presented, together with discussions.

Economics of Instrumentation, by G. W. McCullough, vice president and general manager, Phillips Chemical Co.
Organization of an Instrument Department, by W. H. Fortney, instrument foreman, Humble Oil and Refining Co.
What the Production Engineer Needs in Instrumentation, by H. K. Eckert, manager, Monsanto Chemical Company, Texas City, Tex.
Control of Product Quality by Plant Type Infrared Analyzers, by George A. Martin, Standard Oil Development Co.
Measurement of High Temperatures in Gas Streams, by Andrew I. Dahl, physicist, National Bureau of Standards.
The Effect of Control Point Location Upon Column Control, by K. D. Uitti, Universal Oil Products Co.
"Gadgeteering", by J. M. Jones, Jr., The Texas Co.
Measurement and Control Problems in Typical Fixed-Bed Catalytic Processes, by A. W. Hoge, G. F. Hornaday, and C. G. Walls, Jr., Houdry Process Corp.
Instrumentation Problems in Extraction Processes, by F. J. Spuhler, Humble Oil and Refining Co.
Measurement and Control of Temperature, by David H. Fuller, manager, electronic products, Foxboro Co.

This 99 page, paper covered booklet is published by A & M College of Texas, College Station, Tex.

New Standard Covers Regulations For Safety in Welding

Safety in Electric and Gas Welding and Cutting Operations, American Standard Z49.1-1950, has been prepared by a committee sponsored by the American Welding So-



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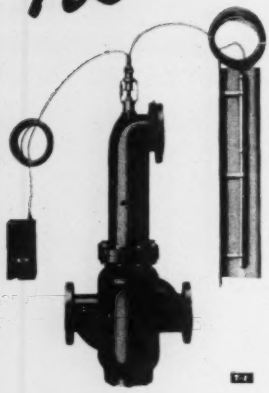

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ciety under the procedures of the American Standards Association. It reflects the best recommendations of welding engineers, safety engineers, equipment manufacturers, insurance organizations, labor organizations, etc.

The standard covers regulations for the safe installation and operation of welding equipment for all arc, gas and resistance welding processes. Provisions are included for fire prevention and protection in regularly assigned welding areas and in other locations as well. The protection of personnel is covered from the standpoint of the welder, for whom eye protection and clothing requirements, etc., are prescribed, and from the standpoint of other workers in areas adjacent to welding operations.

Precautions are specified for the welding of materials which may give off toxic fumes and for welding in confined spaces. The ventilation requirements given have been considerably modified and more clearly prescribed than in the American War Standard.

Copies of this standard are available for 50 cents from AWS headquarters, 33 W. 39th St., New York 18, or from the ASA, 70 E. 45th St., New York 17.

Other Books & Reports Received

DYNAMIC CHARACTERISTICS OF A SOLID ADSORBENT, by W. L. Ross and E. R. McLaughlin, Pennsylvania State College—The performance of silica gel exposed to a dynamic air stream is affected by a large number of variables. The authors describe equipment developed to determine the effects of certain variables independently. Results of a number of tests are presented as summary curves to indicate the magnitude of the effect of each variable studied. The paper was presented at the recent annual meeting of the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18.

SYMPOSIUM ON PLASTICITY AND CREEP OF METALS, identified as special technical publication No. 107, and published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3—The papers in this symposium were presented at the First Pacific Area National Meeting of the ASTM, held in San Francisco, October 1949, and include:

The Experimental Exploration of Plastic Flow in Sheet Metals, by L. R. Jackson and W. T. Lankford, Battelle Memorial Institute.

Forming Parameters and Criteria for Design and Production, by William Schroeder, Lockheed Aircraft Corp.

The Use of Creep Data in Design, by H. C. Cross and L. R. Jackson, Battelle Memorial Institute.

Super Creep-Resistant Alloys, by J. W. Freeman, D. N. Frey, E. E. Reynolds, and A. E. White, University of Michigan.

Copies of this 72 page, paper covered symposium can be obtained from the Society for $1.50.

AMERICAN STANDARD ABBREVIATIONS FOR USE ON DRAWINGS, Z32.13-1950—This revised edition contains special new sections on abbreviations for colors, valves, and screw threads. Over 200 changes have been made in the abbreviations included in the original edition, and more than 40 new abbreviations have been incorporated. The committee which developed this standard was jointly sponsored by the American Institute of Electrical Engineers and the American Society of Mechanical Engineers under the procedures of the American Standards Association. Copies may be obtained from ASA headquarters, 70 E. 45th St., New York 17, for $1.00.

MEETINGS & CONVENTIONS

HEATING SHORT COURSES—Two "engineering institutes", on the pattern of short courses, will be held at the University of Wisconsin. Sessions on steam and hot water heating will be held February 13 to 15 and classes scheduled for March 13 to 15 will cover warm air heating and air conditioning. Enrollments are limited and additional information may be obtained from Prof. H. E. Pulver, University Extension Division, Madison, Wis.

I-B-R SCHOOL OF MODERN HEATING, sponsored by the Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17.—This is a traveling school designed to provide an intensive three-day training in heating design and installation. Classes will be held this month in Providence, R.I., and Reading, Pa. Classes will be held next month in Boston, Baltimore, Raleigh, N. C., and Charlotte, N. C., and a class is scheduled for April in Atlanta, Ga. Additional information may be obtained from the institute.

AMERICAN SOCIETY FOR TESTING MATERIALS, 1916 Race St., Philadelphia—The spring meeting and committee week will be held March 5 to 9, Netherland Plaza hotel, Cincinnati, and will feature a symposium on thermal insulating materials March 7. Papers to be presented at this session include:

Basic Concepts of Water Vapor Migration and Their Application to Frame Walls, by Frank A. Joy, Pennsylvania State College

Emissivity as It Is Related to Insulating Materials, by L. P. Herrington, John B. Pierce Foundation

A Proposed Method of Test for Specific Heat for Thermal Insulating Materials, by Norman H. Spear, John B. Pierce Foundation

Round Robin Tests for Evaluating Thermal Conductivity Methods, by H. E. Robinson, National Bureau of Standards

New and Important Factors Influencing Thermal Conductivity Measurements, by C. F. Gilbo, Armstrong Cork Co.

The annual meeting is scheduled for June 18 to 22 at Chalfonte-Haddon Hall, Atlantic City.

INTERNATIONAL INDUSTRIAL EXPOSITION—March 11 through 17, the Coliseum, Houston, Tex. According to the exposition management, located at 41 San Jacinto St., Houston 2, exhibits will cover oil, refining, chemicals, metals, machinery, power, material handling, welding, instruments, etc.

Free admission tickets will be sent to members of many engineering societies and other organizations, including the American Society of Heating and Ventilating Engineers, the American Society of Mechanical Engineers, and the American Welding Society.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, 919 Milam Bldg., Houston, Tex.—The 1951 conference and exhibition will be held at the Hotel Statler, New York City, March 13 to 16, and plans are now underway for the presentation of 39 technical papers to be presented at various symposia dealing with the water industry, pipe lines, boiler feedwater, the chemical industry, protective coatings, cathodic protection and industrial uses of corrosion inhibitors. Round table sessions will deal with general corrosion problems and also pipe line and underground corrosion.

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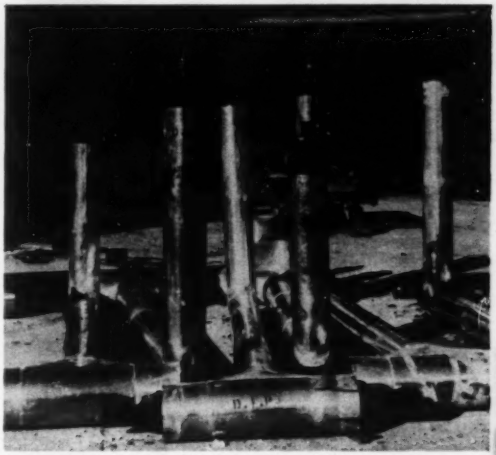

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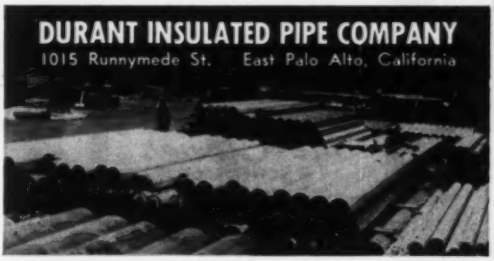

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INSTRUMENTATION CONFERENCE FOR THE IRON AND STEEL INDUSTRY—Sponsored by the Pittsburgh section of the Instrument Society of America, a two-day conference will be held in Pittsburgh on March 28 and 29. Cooperating with the sponsoring organization will be the local chapters of various engineering societies. Further information may be obtained from the general chairman, L. M. Susany, Carnegie Library, 4400 Forbes St., Pittsburgh.

14th MIDWEST POWER CONFERENCE, April 4 to 6, the Sherman Hotel, Chicago. The affair is sponsored by the Illinois Institute of Technology and 18 midwestern universities and professional societies and is devoted to the production, transmission and distribution of power. Secretary of the conference is Edwin R. Whitehead, director of the department of electrical engineering at Illinois Tech, Technology Center, Chicago 16, Ill.

AMERICAN FOUNDRYMEN'S SOCIETY, 616 S. Michigan Ave., Chicago 5—The 55th annual convention will be held in Buffalo, N. Y., April 23 to 26.

MATERIALS HANDLING EXPOSITION—International Amphitheater, Chicago, April 30 to May 4. Industries which will be given special attention in exhibits include paint and varnish, oil, chemicals, and food processing. Simultaneously with the show, which is sponsored by the Material Handling Institute, a three-day conference will be conducted by the American Material Handling Society. Additional information may be obtained from the show manager, Clapp and Poliak, Inc., 341 Madison Ave., New York 17.

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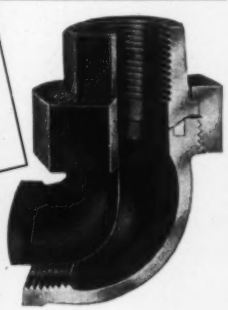

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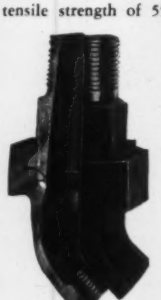

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Air Diffusers

HPAC 101—The Vol. 6, No. 3 issue of the house organ published by Anemostat Corp. of America, 10 E. 39th St., New York 16, features an article describing the installation of the company's new high velocity system in the guest rooms of a Kentucky hotel. Two other articles, one on the importance of air transmission and air distribution in an air conditioning system, and the other on the advantages of the firm's high velocity air conditioning system, are also included.

Air Motor

HPAC 102—The air motor of Bellows Co., 222 W. Market St., Akron, Ohio, is said to utilize the conventional air cylinder with its two ports, its separate directional valve, its two separate speed regulating valves, and to combine them into one integral power unit. Bulletin CL-30 gives detailed information on its design and construction, includes dimensional drawings, and covers the various models available. A feature of the booklet is the information given on numerous applications, including operation of machine tools, tube bending, tube flaring, light stamping and punching operations, etc.

Baseboard Heating Unit

HPAC 103—Vulcan Radiator Co., 26 Francis Ave., Hartford, Conn., has prepared a 16 page catalog (No. 53) on its "Radi-Vector" baseboard heating unit. The catalog gives I-B-R ratings and pipe sizing tables for use in designing the system in series, together with tables for use in designing two pipe steam systems, two pipe forced hot water systems, and two pipe gravity hot water systems. The newest cover designs are described and illustrated and information is given on accessories, including the new rod hanger and improved control dampers.

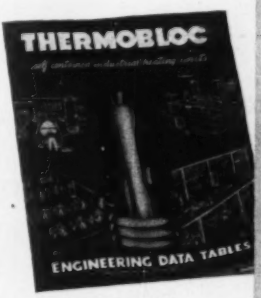
Blower Wheels

HPAC 104—Specifications and performance charts on "Airotor" blower wheels are included in a new 48 page catalog issued by Torrington Mfg. Co., Torrington, Conn. The catalog gives detailed information on the proper use and selection of blower wheels and features a description of the "Coasting Hub" developed for manufacturers of pressure-atomizing oil burners. This device is designed to provide practically full air delivery during the first few seconds after the pump and motor stop so that shutdown is accomplished without soot, smoke or carbonization at the nozzle.

Boiler Crack Inspection

HPAC 105—Bulletin 504 of Dy-Chek Co., Div. of Northrop Aircraft, Inc., 1515 E. Broadway, Hawthorne, Calif., covers the company's dye penetrant method of in-

Here's information you've been Looking for!



- Official Design Temperatures for all states and localities.
- Coefficient of Heat Transfer for common industrial construction.
- Heat loss from window and door, ceiling and floor infiltration.
- Heating constants.
- Procedure to determine heat load.
- Procedure to estimate fuel consumption.
- DataonThermoblocDirect-Fired Unit Heaters.
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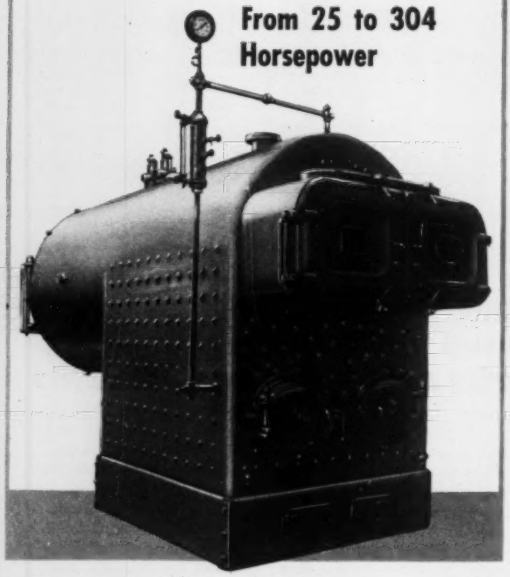

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The *only* all-welded, return tube, firebox type high pressure boiler—providing leak-proof, troubleproof performance on continuous schedules for hospitals, institutions and industries. The Titusville Type WP-WPO Firebox Boiler is precision die formed and welded —built to ASME code with a 5-plus factor of safety—Standardized ratings, with large reserve capacity—gives excellent results with oil, gas or coal firing. Write for detailed, descriptive brochure.

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spection for cracks in metal parts. Inspection of cast iron low pressure boilers and the determination of cracks in boiler firebox mud rings are briefly covered.

Chlorine Feeder

HPAC 106—Builders-Providence, Inc., 345 Harris Ave., Providence, R. I., has issued a new bulletin (840-G27) on the new model HCVS volumetric chlorinizer. This four page bulletin describes the unit which is designed to meter chlorine gas accurately at rates from 100 to 6000 lb per 24 hr and to produce and deliver a chlorine-water solution to the point of application.

Electrostatic Precipitation

HPAC 107—A 15 page bulletin (GEA-5212) of the apparatus dept., General Electric Co., Schenectady, N. Y., describes and illustrates the fundamental principles of electrostatic precipitation for the control of fine particles of dust, smoke, fog, fume or mist. The company does not build precipitators, but does offer electrical equipment required for their operation. A number of rectifiers, both mechanical and electronic, are described and illustrated as are power pack units for air cleaning precipitators.

Expansion Joints

HPAC 108—Catalog 47 of Zallea Bros., Taylor & Locust Sts., Wilmington 99, Del., contains 56 pages devoted to copper and stainless steel self equalizing expansion joints, copper and stainless steel "Duo" equalizing expansion joints, universal expansion joints, low pressure joints, and flexible connectors available in a variety of metals. In addition to giving detailed information in regard to available sizes, dimensions, weights, etc., recommendations are given as to the proper method for guiding and anchoring piping containing these joints. Design data for guides and anchors are included and allowable pressures and temperatures are also covered.

Expansion Joints

HPAC 109—Dresser Mfg. Div., Dresser Industries, Inc., Bradford, Pa., has released a new four page leaflet describing the four principal types of expansion joints which are produced by the company. These types are single end, double end, single end with limited movement, and double end with limited movement. Sizes range from 3 in. ID to 24 in. OD, but the company states that larger sizes can be furnished upon request.

Feedwater Heater

HPAC 110—A new two page bulletin, No. S-201-A, describes the all-steel "Junior" feedwater heater of Swartwout Co., 18511 Euclid Ave., Cleveland 12. The unit is designed for preheating feedwater used in boilers of 300 hp or less. The bulletin includes a cutaway view of the unit, dimensional diagrams, specifications, and shipping weights.

Glass Fiber Ducting

HPAC 111—Arrowhead Rubber Co., Div. of National Motor Bearing Co., Inc., Downey, Calif., has prepared Catalog No. 503 on its "Airtron" line of flexible and rigid glass fiber ducting, hose, sleeves, and couplings. The 16 page manual includes data on weights, working temperature ranges, design working pressures, leakage factors, elongation and compression limits, minimum bend radii,

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Compact
-Reliable
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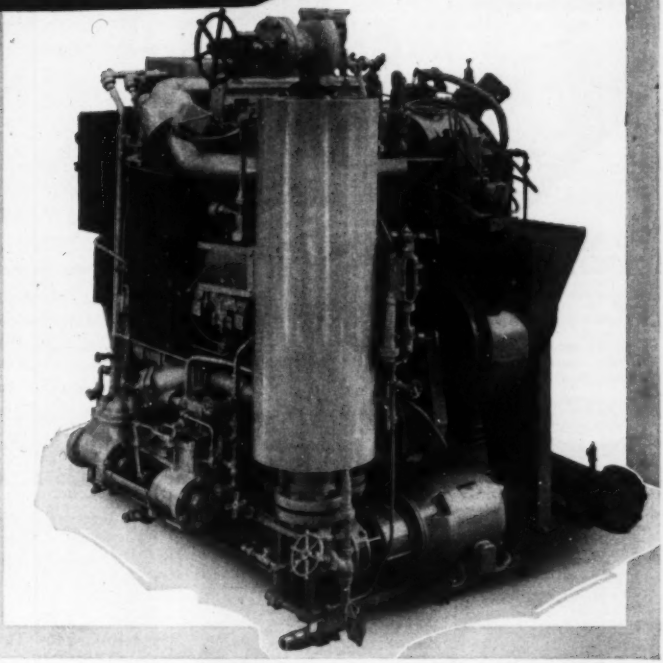

C-E RE-CIRCULATION STEAM GENERATOR

Unit shown at the right is the 6,000 lb of steam per hr size; occupies a space 6'-11" long x 5'-5" wide x 6'-11" high. Other standard sizes — 2800 and 4000 lb of steam per hr.

Do you need steam . . .

. . . for heating, processing or both — in unit capacities up to 6,000 pounds per hour — for pressure up to 300 psi?

. . . in remote locations involving the expense of installing and maintaining long insulated pipe lines?

. . . for intermittent requirements—a few hours each day or week?

. . . for an occasional load which may exceed the capacity of existing boilers?

. . . for a highly fluctuating load which involves sudden heavy demands?

. . . with completely automatic operation; with a minimum of attention necessary?

. . . at maximum output from minimum space?

If you do—if you have any one or a combination of these requirements—your best bet is the C-E Re-circulation Steam Generator . . . more than a package boiler . . . a complete steam plant, including all controls and auxiliaries in a fully integrated unit. Send for bulletin p-323.

B-458A

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ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

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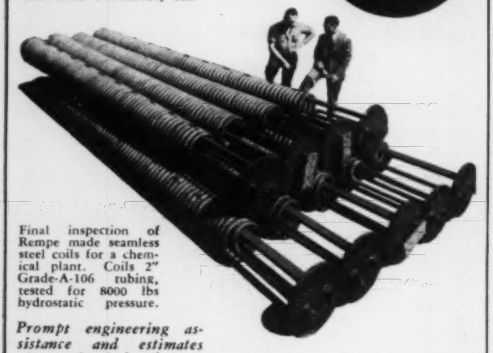

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The two stokers shown in the photograph were among the earliest made by our company. The photo was taken in 1928 shortly after the stokers were installed. One is still operating. The other was replaced in 1949 by a new Brownell stoker.

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Do you want literature? We'll be glad to send it upon request.

THE BROWNELL COMPANY 408 N. Findlay St. Dayton 1, Ohio

etc. Also included are charts giving the comparative characteristics of the more than 130 types of constructions available.

Instruments for Measuring, Recording Weather

HPAC 112—Science Associates, 401 N. Broad St., Philadelphia 8, has issued a folder on its line of weather instruments for amateur weathermen. Equipment briefly described and illustrated includes wind indicators, compasses, combination wind speed and direction indicators, anemometers, thermometers, barometers, etc.

Metal Inspection

HPAC 113—Bulletin 500 of Dy-Chek Co., Div. of Northrop Aircraft, Inc., 1515 E. Broadway, Hawthorne, Calif., describes the company's dye penetrant method of metal inspection and shows how it simplifies nondestructive testing. Dip, brush and spray methods for determining the nature and extent of a surface crack or discontinuity are explained and various applications are discussed.

Multi-Pole Switches

HPAC 114—Rotary multi-pole tap and transfer switches are described in catalog 1950-JR of Electro Switch Corp., 167 King Ave., Weymouth 88, Mass. Sectional, cutaway and exploded views show details of switch design. Diagrams of rotor and stator assemblies and dimensional drawings of switches are included.

Packaged Steam Generators

HPAC 115—"Powermaster" steam generators and hot water boiler units for use with light oil, heavy oil, gas and gas-oil firing are available in sizes from 15 to 500 hp from Orr & Sembower, Inc., Reading, Pa. Bulletin No. 1218 covers design and construction features, advantages, dimensions, capacities, etc.

Piston Rings

HPAC 116—Three new catalogs are available from Double Seal Ring Co., Box 550, Fort Worth, Tex., manufacturer of replacement piston rings for industrial and marine use. The catalogs list products of three of the firm's manufacturing divisions—piston rings, metallic rod packing and "Bakelite" products (including piston rings and rod packing). Included in the piston ring catalog are several drawings of typical ring installations in two and four cycle diesel or gas engines, ammonia compressors, pneumatic compressors, steam engines and pumps.

Pressure Reducing and Relief Valves

HPAC 117—Bulletin 299, issued by A. W. Cash Valve Mfg. Corp., Decatur, Ill., describes a cross section of the company's line of pressure reducing and relief valves. A new automatic reseating relief valve, called "Tempo", is covered and information is also given on a new large size pressure reducing and regulating valve, type E-41.

Refrigeration Specialties

HPAC 118—Sections A and B of Catalog No. 100 of Henry Valve Co., 3215 North Ave., Melrose Park, Ill., cover the company's line of packless and packed valves, relief and check valves, strainers and driers, and liquid level gages for refrigeration, air conditioning, and industrial applications. Information given includes dimen-

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Request our catalogue for information, sizes, capacities, price lists. In 1951 Sweets and A.E.C. Jobbers are invited to participate in our national sales system.

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MODEL NWDH for Controlling Air Conditioning Systems!

The Type NWDH dual switch thermostat with remote bulb for duct mounting is being used in applications in which it is desired to handle two electrical circuits from a single thermal assembly. Typical installations include the control of two compressors, one for normal operation and one for peak loads; or a fan and a compressor.

Standard switches are rated at 15 amps 125/250 V. AC. Switches rated at ¾ hp 125 V. AC, 1½ hp 250 V. AC are also available.

UNITED ELECTRIC CONTROLS COMPANY
87 School Street
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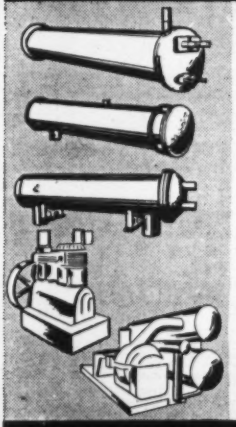
Whatever your control problem may be, United Electric Controls Co. is prepared to assist you. Send full details and drawings. Write for bulletin giving complete details on the control mentioned above.

STANDARD & SPECIAL THERMOSTATS & PRESSURE SWITCHES

QUICK - PROMPT RETUBING SERVICE



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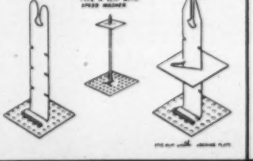

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Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls

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sions, nominal sizes, prices, weights, ratings, and other data pertinent to the selection of equipment.

Spirally Welded Pipe

HPAC 119—Bulletin No. 507 showing typical applications of its "Lockseam Spiralweld" pipe in the construction, dredging, materials handling, mining, oil, paper mill, power plant, and sewage disposal fields has been released by Naylor Pipe Co., 1230 E. 92nd St., Chicago 19. The bulletin includes data on fittings, flanges, and connections. Specifications cover pipe from 4 in. to 30 in. in diameter.

Steel Tubing Terminology

HPAC 120—Bulletin TB-335 of Babcock & Wilcox Tube Co., Beaver Falls, Pa., is a 20 page, pocket-size booklet giving brief descriptions of terminology used in the manufacture and application of steel tubing. According to the company, the booklet is of interest and value to anyone connected with the production and use of steel tubing because the meanings of many of the terms used by the industry are more specific than the ordinary definitions.

Technical Data Catalogs

HPAC 121—Over 2000 listings of its pocket-size technical books are contained in the newly revised catalog of Lefax, Philadelphia 7, Pa. Each of the data books listed consists of approximately 140 pages of tables and data in looseleaf form. Subjects listed include hydraulics, machine design, piping data, metallurgy, metals, relays, meters, heating, air conditioning, mathematics, physics, general chemistry, etc.

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- INSULATES DUCTS
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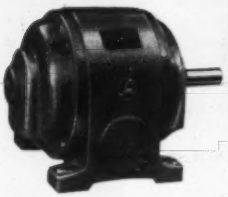

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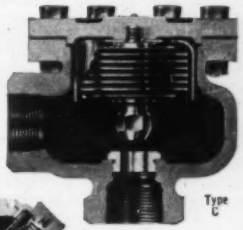
5 TYPES FOR EVERY APPLICATION, process, heat, power. Sizes ¼" to 2"; press. to 225 lbs.



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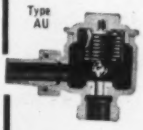

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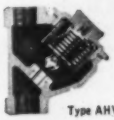

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BULLETIN 450 or see Sweet's

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Carbide and Carbon Chemicals Division

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Oak Ridge, Tennessee

Welding Alloys

HPAC 122—Containing specifications on nearly 100 different "Eutectic" low temperature alloys used in welding, brazing, and hard surfacing of steel, alloy steels, stainless steel, cast iron, brass, bronze, copper, aluminum, magnesium, etc., a new reference chart is available from Eutectic Welding Alloys Corp., 40 Worth St., New York 13. Detailed information is given for each alloy and electrode, including composition, heating facilities which can be used, type and preparation of joints, etc. The chart is identified as TIS 246 P.

Reviews Qualification Tests For Metallic Arc Welding of Piping

In his pamphlet, Pipefitter Welder's Review of Metallic Arc Welding for Qualification Under ASME Code Rules, Robert S. Green, consultant to the National Certified Pipe Welding Bureau, gives the requirements of the qualification tests prescribed by the ASME Boiler Construction Code in simple language and clear line drawings.

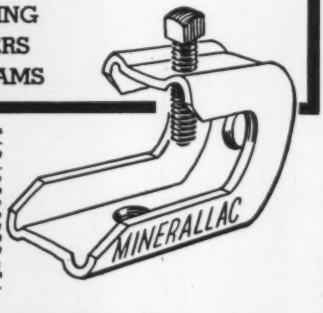
The purpose of this pamphlet is to give the pipefitter welder, facing the test, confidence in his ability to pass it, by reviewing with him the basic steps in obtaining a good weld by this method. How to make a good fusion weld by the metallic arc method is told, step by step, from the preparation of stock to the placing of the last bead.

Copies may be obtained from the National Certified Pipe Welding Bureau, Suite 1401, 1250 Avenue of the Americas, New York 20, for 50 cents.

MINERALLAC

BEAM CLAMPS

FOR MOUNTING HANGERS ON I-BEAMS



Mounts Minerallac hangers No. 0 to No. 6 on I-Beams safely without necessity of drilling holes. Made of heavy gauge zinc plated steel with deep drawn ribs to give needed strength, these durable, light weight beam clamps have ¼-20 tapped holes—will fit beam flanges up to ½ inch thick. Furnished with case-hardened set screw. Low cost.

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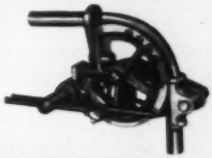

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Plumbing and heating estimator, college man — practical field experience on large commercial buildings and hospitals in Midwest. Prepare field drawings, supervise installation of work, cost records, change orders. Desires change with future. Address Key #888-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

B.S. and M.S. in mechanical engineering with two years' experience with contractor, not subject to draft, desires engineering position in the field of heating and air conditioning. Prefer West Coast but will consider other locations. Address Key #889-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

situation open

ASSISTANT FOREMAN TRAINEE — Opening in pipe shop for young man with mechanical engineering training and experience. Work included supervision of maintenance of pipe lines and heating and ventilating equipment. Large, multi-building, institutional plant in Chicago. Permanent job. Address Key #890-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

for sale

FOR SALE: Three Type C Erie City Cross Drum Boilers, each having 3300 sq. ft. of heating surface and an output rating of 11,385 lbs. of steam per hour from and at 212° F. return water, 160 lbs. operating pressure. Each boiler equipped with four soot blowers, water column, fly ash hopper, 3" steam reinjection system, Copes Feed Water Regulator, two blowoff valves, two pop safety valves and one stop and check angle header valve. Boilers built in 1942, used approximately one year, then prepared for standby. Copies of inspection reports available on request. Boilers at present installed in an idle plant in Central Illinois. Extra equipment available with any or all of the boilers: Three Chicago Automatic Spreader Stokers (some parts missing), two reciprocating duplex steam driven boiler feed water pumps, one Stickler No. 5 Feed Water Heater and Purifier and one condensate tank with two Fischer Flow Control Valves. Will sell part or all equipment in Boiler Room, including valves and pipe work too numerous to list. Associated Sales & Supply Co., 5137 Southwest Ave., St. Louis 10, Mo.

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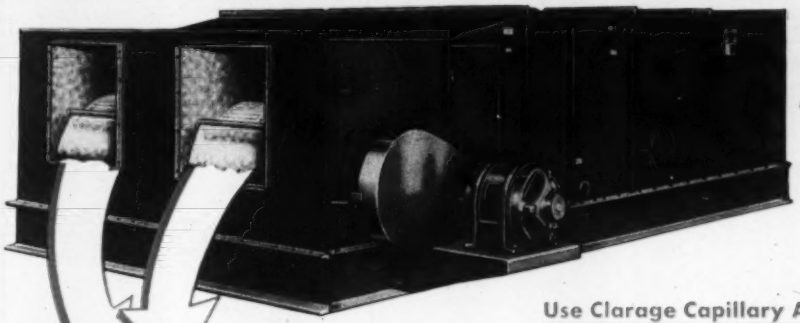
WHEN YOUR PLANT AIR GOES IN HERE



Illustrated is a No. 34H3 Capillary Unit Conditioner with cooling and heating coils, providing complete air conditioning in one assembly.

It Comes Out Here
CLEAN and COOLED
HUMIDIFIED or DEHUMIDIFIED

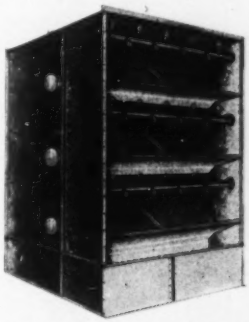
Use Clarage Capillary Air Conditioning Units where Accurate Control of Temperature and Humidity is Important — and where Maximum Air Cleanliness is Vital to Production, Uniform Quality of Product, Health or Safety.

Clarage Capillary Air Conditioners are complete factory assembled units, including a Capillary cleaning section, pump, heating coils, fan, drive and motor. They are available in seven sizes — 1800 to 20,000 c.f.m. Horizontal units, as shown above, are built in both Class I (con-current) and Class II (counter-current) types. Vertical units in Class II arrangement only.

There are excellent reasons for considering this modern air conditioning equipment: (1) Inexpensive to install — no costly building alterations required; (2) Everything in one "package" — no parts to assemble on the job; (3) Proper coordination and performance of all parts assured by factory tests; (4) Low first cost and low operating costs—the result of shrewd, advanced engineering.

★ ★ ★

Write for our Bulletin 122. It gives complete information.

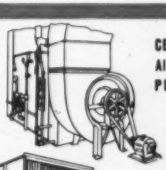


CAPILLARY AIR WASHERS

are available in a series of five height sizes, and in eleven widths — capacities from 4,400 to 132,000 c.f.m. They are built in Class I (con-current), Class II (counter-current) and Class III (con-current with coils) types. Bulletin 120 describes complete line of equipment.

SOME OF OUR OTHER PRODUCTS

UNIT HEATERS



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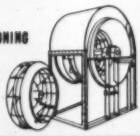

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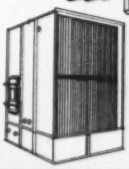
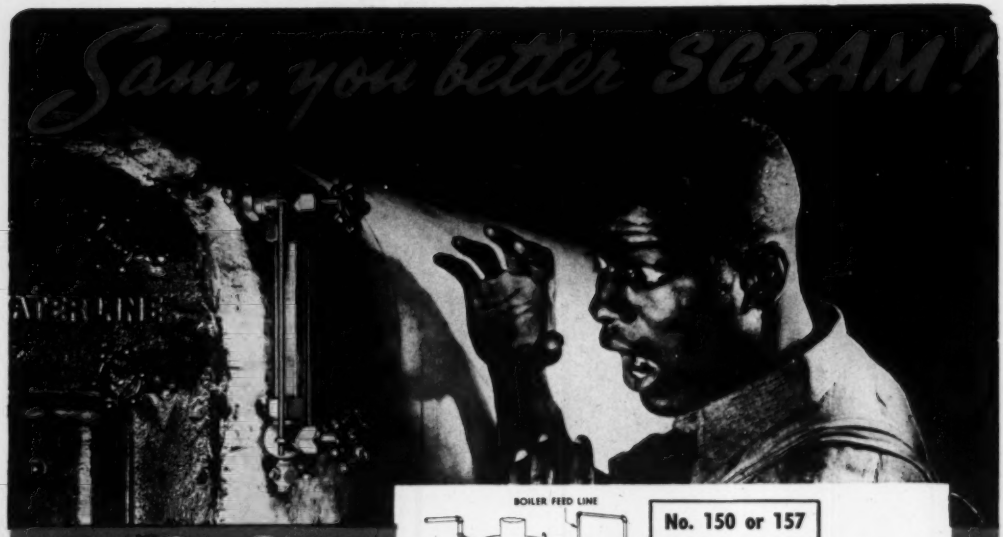


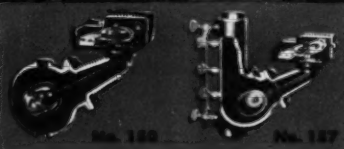
AIR WASHERS

CLARAGE
FAN COMPANY
Kalamazoo, Michigan

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

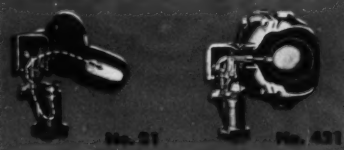
Sam, you better SCRAM!





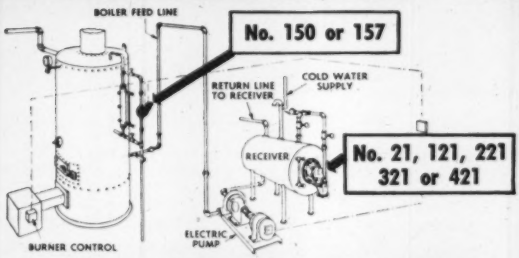
Pump controllers

Highly perfected and proved in thousands of installations, the McDonnell No. 150 is the pump control for boilers with steam pressures up to 150 lbs. Convenient terminals provide circuits for pump motor (or starter), for low water cut-off of burner, and, when desired, for low water alarm. No. 157 (at right) is the same dependable control with integral water column which greatly cuts cost of installation under many conditions.



Receiver tank make-up feeders

To provide make-up water when insufficient condensate is returned to the tank, dependable McDonnell make-up feeders are available. Simplest form when adaptable is the No. 21 series (at left) which is installed right in receiver tank and feeds water directly. Four flange shapes and sizes are provided in this series (Nos. 21-121-221-321) to fit openings in most tanks. The No. 421 (at right) takes care of conditions where installation with equalizing piping is necessary. These quality feeders seat drip-tight against high water pressures.



—but no need to SCRAM with dependable boiler water level control

A steam boiler without automatic boiler water level control is strictly a "Sam-you-better-scram" deal. But there's no need to scram when the job of safeguarding the boiler is taken over by the simple hook-up diagramed above.

It will pay you to study this diagram for a moment and note how the water level (the feed pump) is controlled from the water level itself by a McDonnell No. 150 or 157 pump control. This modern method holds the water level within the close limits that steps up efficiency . . . pays for the control.

An extra switch on the control provides circuits for low water fuel cut-off and low water alarm if a fuse should blow in the feed-pump circuit. The McDonnell make-up feeder on the receiver tank maintains a minimum level in the receiver tank at all times.

Note the facts opposite about the dependable McDonnell equipment that will give you this protection and increased efficiency. Ask for data sheets covering every detail of the simple installation and wiring.

McDONNELL & MILLER, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

Jobber Sales

McDONNELL

Boiler Water Level Controls